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ECOLOGIC INTERPRETATIONS OF SOME BIOSTRATIGRAPHIC TERMS

By CARROLL LANE FENTON AND MILDRED ADAMS FENTON

I.—FAUNULE AND ZONULE *

The purposes of this paper, and the one to follow it under the same general title are:

1. To clarify and re-define certain biostratigraphic terms now in use.
2. To propose certain new terms to supplement earlier ones.
3. To inquire into the nature and bases of these terms, and the nature of the criteria of value in their application.

To a considerable extent, this inquiry into the nature of terms will be along the lines of ecology, even though the terms themselves may not come properly within the limits of that science. We think, however, that several biostratigraphic terms are more closely involved with ecology than generally has been recognized, while others become significant only when they have been given firm ecologic bases. To do this is one of our aims.

Discussion purposely has been restricted to the marine, invertebrate aspects of paleobiology. We have no doubt that

* Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 2.

the terms involved are applicable to other fields, but feel that the limitations of our own studies make it necessary that such application be made by other hands than ours.

Illustrations have been drawn chiefly from the upper Devonian rocks of Floyd and Cerro Gordo Counties, Iowa. It was in studying these formations that we first appreciated the great usefulness of the term faunule, while the demand for such a one as zonule has been precipitated by the work of Mr. C. H. Belanski, on the Shellrock stage. We have profited much from the free use of Mr. Belanski's manuscript, and also from the criticisms of Drs. Walter H. Bucher and Stuart Weller. To the latter we are indebted for the original suggestion of the term zonule.

Mr. Belanski's paper already has appeared in volume 10, pages 317-370 of this journal; and certain differences between his usage of terms and ours are explained by the fact that the present paper was not completed until some months after Mr. Belanski's article went to press.

WILLIAMS' INTERPRETATIONS OF FAUNULE

The word faunule, in a technical paleontologic sense, was introduced by H. S. Williams in Bulletin 210 of the U. S. Geological Survey,—The Correlation of Geological Faunas (1903). In a footnote to page 6 he gives the following definition:

"The term 'faunule' is here and in the following pages used to distinguish an aggregate of fossils associated in a single stratum or zone from the total aggregate of species (the fauna) distributed through a greater or less thickness of strata, each faunule containing a considerable proportion of the same species, but not always in the same combination or proportionate abundance. The association in the faunule is supposed to be an expression of the temporary adjustment to environment and to each other of the living species—an adjustment determined by the relative vigor of each species; whereas the fauna is an aggregate of species determined by several quite divergent conditions and factors, the fauna liv-

ing on so long as these conditions and factors remained sufficiently intact to permit it to preserve its general characteristics and the dominant species to maintain their relative place in the fauna, though for a time suffering more or less variation of composition, due to local and temporary conditions."

The term is mentioned repeatedly in the paper, with explanations or comments that are significant. We select three:

"When a fossiliferous stratum is discovered . . . . the paleontological observer stops and samples the stratum. The fossils thus gathered constitute a *faunule*," (Page 24.)

"The faunule is a sample of the fossil contents of a fossiliferous zone . . . ." (Page 24.)

"A fauna is an association of species which for some reasons naturally live together . . . . A faunule is a local sample of the fauna." (Page 29.)

On page 131, finally, Williams gives a "revised definition" of the term faunule, as follows:

"In the process of collecting fossils it is necessary to keep separate records of the specimens taken from each fossiliferous stratum of each separate outcrop. The group of specimens from such a unit stratum (or from several contiguous strata in which the same set of species are distributed) is called a *faunule*. It is a sample of the general fauna of the formation, coming from a definite horizon in the local section and from a definite geographical position. A faunule will exhibit the local and temporary aspects of the fauna, and in most cases it will contain only a small part of the species which properly belong to the general fauna. The faunule may be regarded as closely adjusted to a particular set of environmental conditions, which, though not known, may be to some degree inferred by the character of the sediment in which it is found. It is often observed, however, that successive faunules in a column of strata differ greatly, although very slight change in character of sediments is observed. Living faunas in modern ocean waters so differ on account of differences of temperature or other conditions of the water, and it may be supposed that such differences affected in a similar way the ancient geological faunas."

In the next paragraph Williams turns to the rocks which afford a faunule, saying:

"The particular part of the formation, be it a single stratum, or a few or many feet of thickness of rock throughout which the faunule is recognized is properly a *zone*, as defined on page 20; and the locality, number, and name may be applied to the specimens of the faunule, as well as to the stratum or strata from which they came."

Page 20 affords a general discussion of fossiliferous and barren zones that is not significant here; but page 22 contains a statement that is important, and will be referred to farther on. It is:

"A zone may be traced from place to place, as may the formation itself . . . ."

We now may turn to Williams' notable report on "Recurrent Tropidoleptus Zones of the Upper Devonian in New York,"—Professional Paper 79 of the U. S. Geological Survey (1913). Once more we select but a few of the possible quotations:

"In the work for this paper 1,411 separate faunules were collected and examined . . . ." (Page 8.)

"The faunules listed above are the individual local collections made and recorded in the field. When these collections were studied in the laboratory the separate lots from contiguous strata found to contain the same fauna were for individual sections combined and treated as a single faunule. . . (Page 43.)

"In the Harford quadrangle the recurrent faunule of zone No. 1 has been detected at three or four separate horizons ranging through at least 100 feet . . . ." (Page 79.)

"Specimens of the genus Rhipidomella have been detected in 88 of the 1,411 individual collections of faunules examined . . . ." (Page 42.)

The interpretation which Williams gave the term zone in 1913 is well illustrated by Fig. 2 of Professional Paper 79, in which several zones are shown to extend well beyond the limits of a single quadrangle.

CONFLICTING INTERPRETATIONS

If we now scrutinize and compare the definitions and characterizations of the term faunule that have been quoted, it becomes plain that Williams had in mind three different things. The first of these is a group of organisms, dwelling in a more or less restricted area, and adjusted to themselves and their inorganic environment. The second is a collection of fossils, from one or several contiguous strata, at one locality. The third is a group of fossil organisms, not clearly a community, which characterizes a given stratigraphic unit, or zone.

Beyond reasonable doubt, Williams had the organic group or community in mind when he framed his first definition. The members of this community, of course, were present only as fossils; but they once were alive, adjusted to their environment and each other, though varying somewhat in their relative abundance from spot to spot. All these are attributes of organisms, not of fossils in a collection.

It is just as plain, however, that on page 24 of Bulletin 210, Williams is thinking of the collection—"the fossils . . . . gathered." On page 43 of Professional Paper 79 he is even more explicit: "The faunules . . . . are *inidvidual local collections* . . . ." (Italics ours.) But in his "revised definition," Williams incorporates both the idea of organic community and that of collection. "The group of specimens" is a faunule; but the faunule seems to be "closely adjusted to . . . . environmental conditions," responding to them as do modern faunas, and smaller ecologic groups. Moreover, a faunule characterizes a zone; and though it is not thoroughly clear that in this use of the term Williams was accepting the faunule as a community, certainly he was not considering it to be nothing more than a collection of fossils from one locality or outcrop. Such an interpretation clearly is ruled out by the statement that a zone "may be traced from place to place, as may be the formation itself. . . ."

Finally, in spite of his clear statement on page 43, and his use of faunule in the bulk of the book, Williams returns, on page 79 of the "Recurrent Tropidoleptus Zones," to the

concept of faunule as a faunal community, when he says: "In the Harford quadrangle the recurrent faunule of zone No. 1 has been detected at three or four separate horizons ranging through at least 100 feet, although in the section at the typical locality (Van Etten) it [the zone] appears to be not over 20 feet thick." This zone extends into at least two fifteen minute quadrangles, and according to Williams' definition of zone (Bulletin 210, page 131) the faunule must do likewise. In keeping with this interpretation of faunule, also, is an expression found on page 42 of Professional Paper 79: "individual *collections of faunules.*" (Italics ours.)

There seems no need to review in detail the use of faunule by other authors than Williams. In the first place, the term is rare in paleontologic literature; in the second, we have found no other writer who has critically analyzed the term, even when he used it.

We may say, however, a word about our own use of faunule in the "Stratigraphy and Fauna of the Hackberry Stage of the Upper Devonian" (New York, 1924). In giving the range of several forms—*Strombodes marginatus,* for example —we referred to the faunules in which they were found, or were dominant, the stratigraphic position of these faunules being given in a series of sections printed on pages 10 to 13. In these sections, unfortunately, the name of the faunule is given in the position which should be occupied by that of a stratigraphic unit, as in this example from page 12:

2. Whitneyi Faunule. Gritty, blue beds with casts of *Atrypa, Spirifer, Schizophoria,* etc.; at the top there are traces of No. 3 of the Rockford section 8

It now seems to us that the practice of giving ranges in terms of faunules, while perhaps not generally useful, is in keeping with Williams' major definition, and the one we propose to adopt; but that the use of faunule in place of a stratigraphic term, as in the example quoted, is inadmissible. It would give the term a stratigraphic meaning, implicitly if not explicitly, and such a meaning not only would be distinct from any given the term by Williams, but would violate the

word itself. We therefore abandon this objectionable usage, and in further discussion of faunule shall limit ourselves to Williams' interpretations and definitions.

FAUNULE AS A COLLECTION

Having found that Williams gave the term faunule two, or even three distinct meanings, we confront these alternatives: either the term must be dropped, or it must be defined anew in accordance with one or another of Williams' interpretations. The former seems undesirable since, as we shall show farther on, there is need for such a term as faunule. Therefore, it is necessary for us to decide which of Williams' meanings to accept,—which of his interpretations to follow.

At the outset, we may dismiss without detailed consideration Williams' third interpretation of faunule, as the assemblage of organisms which characterizes a zone. To us this seems no more than a supplement to his major interpretation, as community; since a fossil community, or community-like assemblage, may and often does characterize a statigraphic unit, even though we should not call that unit a zone. But the most significant point is this: that Williams gives his third interpretation casually (and ambiguously) and does not return to it,—from which we may conclude that he himself did not consider it as very important.

Let us now turn to the concept of faunule as one collection, from one or a few contiguous strata, at one outcrop. In this sense a collection becomes a faunule only by virtue of the care used in making it and in preserving data; and the use of the term implies that the precision of these data is comparable in the case of all collections to which faunule is applied.

This, unfortunately, need not be true. In precision, the data accompanying a collection from a six-inch bed with an exposure roughly five by twelve feet are not comparable to those of a collection made from a four-foot member exposed in an escarpment five thousand feet long. In linear precision alone the data differ as twelve differs from five thousand. Moreover, in the mile-long outcrop that we have in mind,

there is one member which, in various parts of the exposure, contains different organic assemblages, while the six-inch bed, in the five-by-twelve foot outcrop contains but one assemblage. Yet Williams' definition of faunule as collection would demand that collections from both of these memebrs, *in toto*, be called faunules. Clearly that definition must be modified to read "collection from one outcrop or part of an outcrop." Without such modification, the faunule ceases to be a natural unit, and invites confusion rather than clarity.

Let us now consider the other extreme. Williams unites several faunules (collections) into one if they belong to one biologically limited stratigraphic division *at one outcrop*. But what shall we do with those not uncommon cases in which the same organic community is present, in apparently identical strata, at several outcrops a number of miles apart? Shall the collections from these be made distinct faunules, with different names, as the definition requires? Or shall we adopt the more rational device of uniting them under one name, as one faunule, and thus avoid confusing and constantly multiplying synonyms?

If the modifications of definition suggested by these last paragraphs are accepted, the revised definition of faunule as collection will read about like this:

A faunule is one or several collections, from one or several contiguous and faunally related strata, at one outcrop, part of an outcrop, or series of outcrops in which this stratum or these strata afford specimens which indicate the existence of one continuous organic community.

The significant thing about this definition is not its series of alternatives; it is the shift of emphasis from *oneness* of locality to *continuous* unity or organic content. To us it seems that collections whose affinity is determined by the fact that they come from one stratigraphic unit at one outcrop are very different things from collections whose affinity is determined by the fact that the rocks from which they came seem to contain one continuous organic community, whether at part of one outcrop, or throughout a dozen outcrops. If one accepts our second definition he must discard the first.

But why accept either? We have seen that the implied precision of data may be an illusion—yet what other justification have we for calling a collection by some name other than collection? Moreover, these very qualities of precision are attributes of all really careful collecting; and as conditions of field work improve we may (theoretically, at least) reach a state in which most collections, in this sense, might be called faunules. Collection, then, would become a term of deprecation or reproach, indicating that time was short, talus thick, cliffs steep, or that the collector had neglected an opportunity. Such a distinction seems hardly to possess scientific validity.

In conclusion: we find that the term faunule, in the sense of a collection, has no place in biostratigraphy. Introduced as a precise term, its precision is relative—and without emendation of the original definition, illusory. One of its essential criteria, oneness of outcrop, fails of application, and a new criterion, of organic unity, must be introduced. Finally, the precision denoted, while based on nature, depends primarily on factors more or less independent of the strata and fossils; followed to its limit, it produces distinctions which are arbitrary and absurd.

FAUNULE AS A FAUNAL ASSEMBLAGE

We now may turn to the other conception of faunule, stated by Williams in his first definition of the term, in the first part of his "revised definition," and implied in his conception of zone and in the more general descriptions of his Professional Paper of 1913.

As a basis for discussion, we may take Williams' first definition, quoted on page 2 of this paper. According to it, a faunule is not a collection, but is the fossil representation of a group or community of living animals, that dwelt in a limited area during a limited period of time, and that were closely adjusted to the environment, of which they themselves formed an important part.

Unfortunately for the paleontologist, he is forced to give much latitude to the word "representation;" this latitude being

demanded by irregular operation of those processes by means of which organisms are buried and fossilized. To be truly, accurately representative of the once living community, a group of fossils should not merely afford the important species of the group, but should preserve them in approximately their correct proportions, and without additional or intrusive forms properly belonging to another habitat, and therefore, another community. Features of the organisms or their preservation, also, should give more than hypothetical evidence of their life habits.

These conditions, however, fossil assemblages rarely meet. Forms with hard parts are preserved while those without them disappear. Large, massive ones, such as many of the corals and bryozoans, stand out more prominently than their numbers justify, and are more common in collections than are their small contemporaries. Plankton and nekton, when preserved at all, lie among dwellers of the sea bottom, while many a shell has drifted far from its original habitat.

Of course, there are various criteria by means of which the accuracy of fossil representation may be gauged. If the community is a coral reef, affording organisms of the sort that normally inhabit reefs, one may assume that few intruders have been washed in. If amidst thousands of perfectly preserved brachiopods and corals, without a sign of wear, one finds delicate Auloporoids adhering to the still semiplastic clay of the one-time seabottom, he may assume that this sector, at least, was undisturbed by waves or currents. On the other hand, broad ripple marks, worn fragments of shells, and flat valves on edge in imbricating channels, all give equally conclusive evidence of disturbance.

But such conclusive criteria are not always available. Also, it may not be the purpose of the paleontologist to concentrate upon a group so limited that it is properly an association, even if it can be distinguished. In either case, what he has for study is a representation of the plant or animal population of a given area during a given time, minus unknown subtractions, plus undetermined (or undeterminable) additions, and representing, probably, more than one habitat.

It is such an assemblage, we believe, that Williams had in

mind when he first defined the term faunule, and it is to such an assemblage that we would apply the term today. There is no other which properly may be used. As Williams shows, fauna has too broad a meaning; ecologic terms cannot be applied, since the assemblage is but partly determined by ecologic criteria. On the other hand, the term faunule fits excellently, and it has no other valid significance.

It is clear, however, that though a faunule is not an association, it is dominated by the representatives of one community which in all probability is (or was) an association.[1] This is true of the faunules we have chiefly in mind—those of the Hackberry Stage (Upper Devonian) of Iowa, and the ones distinguished by Belanski in the Shellrock strata of the same region. There is, for example, one faunule dominated by large, massive colonies of the bryozoan *Liocloma occidens*, with the various brachiopods, corals and other animals that grew among, upon and even within the bryozoan masses. Another faunule is characterized by abundant, large brachiopod shells of the genera *Atrypa* and *Spirifer;* a third by thousands of rugose corals and their ectoparasites; a fourth by abundant, massive stromatoporoids and corals.

In each of these faunules, therefore, it seems possible to pick out the dominant association; certainly one may distinguish those small organic communities which the ecologist calls layer societies, or strata.[2] On the other hand, each fossil

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1 An association may be defined briefly as a qualitatively and quantitatively homogeneous community of plants or animals, occupying a common habitat. For a discussion of the ecological classification of plants, see Nichols, Ecology, vol. 4, pp. 11-23, and 154-179, 1923. The classification which Nichols proposes can be extended to animal communities with but little change.

2 The term stratum was used by Shelford (Animal Communities of Temperate America, p. 37, 1913) to designate a group of animals within an association, living at approximately the same level. Since this interpretation conflicts with the standard stratigraphic meaning of the term, it cannot be accepted in paleobiology.

The equivalent term, layer society, is defined by Nichols (1923, p. 14) as "a plant community within an association which results from the tendency of various species of smaller size than the dominant life-form to display their foliage at more or less definite levels." As ex-

assemblage contains remains of organisms which did not enter the dominant association until they died and sank to the bottom, others, members of the nekton and vagile benthos, that entered and left more or less at will, and still a third group concerning which evidence is not and may never be convincing. It is these three groups that make the assemblage distinct from any purely ecologic group, and demand for it some peculiar designation, such as faunule.

A faunule, therefore is not truly an ecologic unit, even though it is in part determined by such a unit, or community. From this it follows that in distinguishing faunules we must give attention, not merely to index species or faunal lists, but to the essential faunal constitution of the assemblages in question. Two fossil assemblages may afford almost identical lists of species, and contain the index fossils of the formation or zone, and yet form faunules that are absolutely distinct. To the casual collector many of the faunules of the Hackberry stage would seem identical, yet as the four examples that have been given indicate, their dominant life-forms are very different. In the first, this dominant form is the massively branching bryozoan, *Lioclema occidens*, fragments of whose zoaria are present in thousands. In the last, the dominant life forms are massive stromatoporoids, and twelve years of collecting have brought to light but one small fragment of *Liocloma occidens*. Yet in the ordinary, non-annotated faunal list this single fragment would stand out quite as prominently as the thousands of specimens from the other faunule! Even such qualifications as "very rare" and "abundant" will not bring out the contrast.

The most satisfactory method for determining the true complexion of a faunule seems to be this: In the two or more strata whose faunal contents are to be compared, areas are selected which are comparable in slope, in size and in degree

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amples he quotes the small tree, tall shrub, low shrub and herbaceous layer societies in an oak-hickory forest. In a crinoid-bank (association) the snails and other organisms about the crinoid bodies, and the molluscs, bryozoans, etc., about their bases form equally distinct layer societies.

of weathering, and which are free from the talus of higher beds. From these areas of exposure every available fossil is taken, while notes are made concerning the matrix and exposure, and any other features than may be significant. When the fossils have been identified, their names are tabulated, with the number of specimens in each case; and the result is census tables of the faunule or faunules.

In analyzing these lists, each form must be weighed according to its significance, and that of the parts which represent it. A thousand echinoid spines have not the significance of a thousand snail shells—yet if one bed affords a thousand spines and another but one, there is at least indication that echinoids are more common in the former. Similar considerations apply to such forms as the branching bryozoans, to crinoids, and to all other animals in which one individual may be represented by many pieces.

Somewhat similar considerations enter when one seeks to determine the ecologic importance of several forms. One may find two hundred ostracods, and still may not call ostracods the dominant life-forms of a particular faunule; but if in the same space he finds thirty masses of *Prismatophyllum*, he will call that form dominant, state that the faunule is dominated by a *Prismatophyllum* community, and name it accordingly.

In some cases, of course, the collection-census method of faunule analysis cannot be applied. In them the collector will devise a method that fits the conditions, and do his best to gain an accurate idea of the complexion of the faunule.

In the great majority of cases, naturally, a faunule will contain many species, not three, six or a dozen. But to this rule there will be exceptions: particularly those faunules whose dominant life-forms built large colonial masses, and whose environmental conditions were such that small species were rarely preservd. But even in such cases species will not determine the faunule; it is their relative abundance, and the presence of some of them in communities, which furnish the decisive criteria.

Another exception, more apparent than real, will be found

in the faunule whose dominant and subdominant life-forms are so large and abundant as to render the other species relatively insignificant. Thus in a stromatoporoid reef, one or two species of stromatoporoids, and perhaps a coral or two, may form ninety per cent of the *mass* of the faunule; and for practical purposes they alone may be identified. But the other forms exist, and form part of the faunule, so that in careful work (generally the only sort in which faunules will be recognized) they will be listed, and their proportionate abundance noticed.

In summary, therefore, we may say this: that, although the faunule is not a truly ecologic unit, the criteria by which it is distinguished, and the methods by which its constitution is determined and described, are primarily ecologic. Under no conditions can it be defined merely in terms of index species.

Because of this last statement, it may be well to add a word about those fossil assemblages which, though they contain several species and many specimens, afford no recognizable trace of organic communities. Into this group fall shell beds accumulated by waves and currents, comminuted masses of exoskeleton with here and there an identifiable specimen, the fossils of sparsely fossiliferous beds, and many similar accumulations. Obviously enough, such assemblages were determined by physical agents, not by ways of life. At their base is no ecologic unit or community; they represent neither adjustment to environment, nor of organisms to each other. To them, therefore, the term faunule cannot be applied. They are simply assemblages, and nothing more.

RE-DEFINITION OF FAUNULE

We come now to the point where we may offer a revised definition of the term faunule. For the science of paleontology alone, this may be phrased as follows:

A faunule is an assemblage of fossil animals, associated in one or a few contiguous strata, and dominated by the representatives of one community, commonly either an association or a layer society.

It seems doubtful, however, that the term should be restricted to paleontology. To the ecologist, of course, it may be useless, since he has more precise terms that fit his needs. But zoologists often describe animal assemblages which extend beyond the limits of one community. Particularly is this true of those who work with dredging samples, containing benthos, nekton and plankton in one lot; and to these workers the term faunule should be welcome.

It seems, therefore, that any general definition of faunule should allow it to be used by both zoologist and paleontologist, without conflict of meaning. This is not difficult, since the qualifications which would restrict the term to paleontology are not essential. A fossil animal differs in no essential character from a living one—particularly if the latter is dead. Association of fossils in one or a few strata may be taken for granted if their assemblage is dominated by a community, since a community is a temporary affair at best, and even in the sea is not apt to endure through geologically long periods.[3] Therefore, though we may allow the paleontologic definition to stand as precise and specific (though by no means final) for that science, it seems well to give the term *per se* a more general definition, such as this:

A faunule is an assemblage of animals dominated by one community or its representatives, but including organisms which, though found among the members of the community, do not belong to it.[4]

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3 Exceptions may be necessary for such communities as the larger coral reefs. But for those of the Paleozoic the generalization seems good.

4 The term florule, being the counterpart of faunule, presumably may be defined similarly, by the substitution of "plants" for "animals." This also is true of the purely paleontologic definition.

DUAL USE OF FAUNULE

Like the purely ecologic term association, faunule may be used in two senses, concrete and abstract.[5] At first this may seem unnecessary and confusing; actually it accords with our common daily practice. We speak of the pine woods of Florida, and of the pine woods two miles east of Crystal Beach, Florida, but the two are distinct. The first is a generality, an abstraction; the second is a precise thing—a bit of woodland that anyone may locate and examine. The same applies to such examples as the seashore, and the seashore at Woods Hole, Massachusetts, and many others that might be mentioned. Even the names of geologic formations are given dual usage, though the contrast is more between general and specific than between abstract and concrete.

In the case of faunule, however, the duality of usage principally will involve the concrete and abstract. In the former sense the term will signify a particular faunal assemblage: for example, the Actinostroma expansum faunule at Nora Springs, Iowa. In the latter, it will signify an abstract concept, based, it is true, upon specific cases, but itself neither specific nor tangible. Such usage is adequately illustrated by the following statement: "The Actinostroma expansum faunule, wherever it appears, maintains the character of a bottom reef in shallow, but quiet water."

CORRELATION AND RECURRENCE OF FAUNULES

The existence of a faunule is determined by the presence of members of a definite organic community, plus organisms not members of that community, and still others whose position is in doubt. The constitution or complexion of the faunule is determined by the nature of the constituent animals, their relative abundance, and their relationships to each other.

5 On the dual use of association, see Nichols, Ecology, vol. 4, pp. 14-17, 1923. This article, which seeks to rescue ecologic nomenclature from the complexity into which it has been carried by some enthusiastic classificationists, constantly has been at hand during the preparation of this paper. The classification of Shelford, already mentioned, is important, particularly since it relates directly to animals.

It follows, therefore, that when two assemblages correspond in these particulars, they are to be considered representatives of the same faunule, and may be given the same faunule name.

In such a case as this there are three possibilities. If the assemblages appear in outcrops not widely separated, and in apparently continuous strata, one may assume that the community which dominates them is continuous, and that they represent a single faunule, in the concrete sense of that term. This seems to be the condition Williams had in mind when, calling the rocks bearing a faunule a zone, he stated that the latter might be traced from place to place.

On the other hand, the exposures commonly are far apart, while between those in which one member bears two similar assemblages are other exposures in which the same member bears a faunule or several faunules unlike the first. In such cases continuity can not exist, even though some of the assemblages are similar—homologous, in both constitution and stratigraphic position. In the concrete sense they form two faunules, even though they may be considered as individual examples of the general abstract faunule.

Examples of this sort are common in modern seas, as well as in the deposits of ancient ones. Coral reefs, contemporaneous and essentially similar, are separated by areas of bottom that do not bear reefs. Colonies of *Mytilus edulis* grow in isolated spots, surrounded by deposits of black mud; beds of oysters, sponges and other marine organisms are separated as distinctly. And although they now form communities, their fossil counterparts may more properly be termed faunules—homologous faunules—in the majority of cases.

Just what the limits of vertical disparity between faunules of this type shall be must depend upon the nature of the formation in which they occur. In the upper Devonian of Iowa, with numerous stratigraphic units, commonly separated by unconformities, a few feet or even inches may make a great difference in age. On the other hand, we are inclined to consider the reefs of the Racine dolomite in the Chicago region as homologous, since there seems to be (at present) no good basis for stratigraphic distinction. The cores of the tepee buttes of the Pierre shales, described by Gilbert and

Gulliver,[6] contain other examples of homologous faunules which may not be strictly contemporaneous.

There remain those cases in which apparently or actually similar faunules occupy levels so different, or strata so distinct, that the term homologous cannot be applied to them. If the similarity is real, embracing both the dominant community and the more important of the secondary or incidental forms, we may conclude that the faunules actually are equivalent in constitution. They therefore correspond to the recurrent faunules of Williams (miscalled *zones;* Professional Paper 79), and to them this designation may be applied.[7]

Commonly, however, the similarity between distinctly non-contemporaneous faunules will prove to be apparent rather than real. During the passage of time organisms, unless they become extinct, continue reproduction; and all of them, even the "arrested" types, are subject, during this process, to some evolutionary change. To paleontologic perception, moreover, evolution seems a nearly continuous process; even mutations are apt to appear so against the background of geologic time.[8] Unless the period separating two faunules is very slight, therefore, many of their organisms will show modification—especially those in the so-called racial reproductive period, such as the "species" of *Spirifer* in the Hackberry stage, and of *Cyclonema* and *Platystrophia* in the Cincinnatian and Richmond.[9] Under such conditions there is

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6 Bull. Geol. Soc. Am., vol. 6, pp. 333-342, 1895.

7 Actually, only those faunules after the earliest recur; yet all of them form a recurrent series. Moreover, the abstract or generalized faunule, which includes the first as well as the last of the series, recurs. With this understanding, the term recurrent, when convenient, may be applied to the original faunule without grave abuse of words.

8 See W. D. Matthew on the Evolution of the Horse, etc. (Quart. Rev. Biol., vol. 1, pp. 139-185, 1926), for a discussion of this point.

9 A striking example of rapid evolution is furnished by the modern genus of lung-snails, *Partula.* See H. E. Crampton on Contemporaneous Organic Differentiation in the Species of Partula living in Moorea, Society Islands (Am. Nat., vol. 59, pp. 5-35, 1925). More elaborate discussions of the genus, by the same author, are to be found in publications 228 and 228A of the Carnegie Institution of Washington.

small chance that the organisms composing non-contemporaneous faunules will be alike, even though they may not always be so different as to separate the faunules.

Still other factors make actual recurrence of faunules uncommon. Not merely must the dominant community reappear without any very considerable modification of its constituent elements; into this community must come virtually the same array of extraneous and uncertain species that accompanied its first appearance. And even though a good deal of latitude be given the qualifications "considerable" and "virtually," there still is small chance that in any individual case these conditions will be met. In our own work we have found no case in which a faunule recurs, nor has Mr. Belanski encountered recurrence in the Shellrock, whose faunules are numerous and well developed.

On the other hand, recurrence doubtless does occur—Williams' recurrent "zones" of Tropidoleptus seeming to be a case in point. Commonly, however, the recurrence will involve, not the actual faunule, but an abstract, almost ideal grouping of organisms which we may call the *faunule type*, and which involves ecologic and taxonomic resemblance, rather than equivalence. This is strikingly shown in Cenozoic and recent coral reefs, and in the long series of oyster beds of past and present periods. In both of these examples distinct faunule types recur unknown numbers of times, while actual recurrence of faunules is relatively uncommon.

There doubtless are cases in which one element of the faunule—the association or layer society—actually recurs, although other elements do not repeat themselves. In such cases one may speak of the recurrent community, whatever its rank, but not of recurrence of the faunule, since it is more than a community. As in the examples quoted in the preceding paragraph, the similar but non-contemporaneous faunules lack a common essential constitution, and are analogous rather than recurrent.

In summary, we may give the following classification of faunules with reference to their repetition, both areal and vertical:

Homologous Faunules. Faunules of essentially equivalent

constitution, generally occupying the same stratum or member, and virtually contemporaneous.

Recurrent Faunules. Faunules of essentially equivalent constitution, but occurring at distinctly different horizons, and therefore not contemporaneous.

Analogous Faunules. Faunules occurring at distinctly different horizons, not of equivalent constitution, but characterized by a common faunal type.

NAMES OF FAUNULES

It seems desirable that a faunule be named, when possible, after the dominant life-form of its characteristic community. Not always, however, is this possible; the dominant form may be very imperfectly known (almost any stromatoporoid, for example), or the name may have been used in some other connection, thus inviting confusion if it were applied to the faunule. In such instances names must be devised which seem best to meet the needs of the case.

Our present preference is for both generic and trivial names, if a faunule is named for a particular species. But the point does not seem a vital one, and if one term will do as well, as Mr. Belanski has found in the case of the Shellrock faunules, the addition of another word may be undesirable. Fortunately, the case is one in which uniformity is not vitally important, though precision and clarity are.

ZONULE

On page 6 we commented unfavorably upon our own use of faunule in a stratigraphic sense. We return to the matter with the proposal of a new term.

In many cases the vertical and horizontal ranges of fossils may be given in terms of the faunules of which they form parts. Not always, however, is this the case, and in sections and stratigraphic descriptions the term faunule obviously will not suffice. Of course, one might use such an expression as "beds containing the *Pugnoides calvini* faunule," but the device is so clumsy as to be nearly worthless.

Williams (Bulletin 210, page 131) applied the term zone

to the rocks containing a faunule, though he seems not to have held uniformly to this interpretation. It seems to us, however, that to follow Williams in this would be to restrict the term zone undesirably, violate established usage, and greatly lessen its usefulness.

The term subzone, suggested by the United States Geological Survey (letters of July 28, 1926 and January 26, 1927) does not seem appropriate. Like substage, it suggests a division into vertical, not areal, units which are apt to be coextensive with the larger unit, whether stage or zone. But a division based upon faunules is both areal and vertical, and rarely indeed does a faunule extend over the same area as a zone. To us the idea of numerous subzones, all at one stratigraphic horizon, is confusing and contradictory. Finally, there seems to be need for the term in another, and more appropriate sense.

We have discussed the need for some new term to designate the rocks bearing a faunule with several stratigraphers. In the course of one conversation Dr. Weller suggested "zonule," and it has been approved by the others, among whom are Dr. Walter H. Bucher and Dr. E. M. Kindle. We propose the term, therefore, with the following definition:

A zonule is the stratum or strata which contain a faunule, its thickness and area being limited by the vertical and horizontal range of that faunule.

It seems desirable that a zonule be given the name of the faunule which it contains. If the faunule is repeated homologously the zonule also is repeated. If the faunule is repeated by recurrence, it seems desirable that the zonule name be preceded by one of the numerical adjectives, in order that the zonules of different levels may be distinguished.

Following the nomenclature proposed for faunules, zonules bearing homologous faunules are themselves homologous. On the other hand, it seems necessary to call those zonules bearing recurrent faunules analogous. For a zonule consists of rocks, not organisms, and rocks are fixed, powerless to migrate, and biologically, have no descendants. The rocks of analogous zonules may be very simliar, but that similarity is very different from similarity based on organic continuity.

If it represents recurrence of any sort, it is of sedimentary type, not of actual beds. Recurrent zonules do not exist—nor do recurrent stratigraphic units of any other rank.

There remain those zonules which bear, not recurrent, but analogous faunules. It seems that they too may be termed analogous, even though their relationship differs from that of the analogous zonules just discussed. To us, that difference does not seem so great as to warrant the introduction of another new term.

BEDS

As we have said, several zonules generally occur at one horizon, in a single stratum or member. In many cases they are adjacent or even intergrade, but in others they are separated by expanses of rock which either are barren, or hold assemblages of fossils too poor to form faunules. Similar non-faunuliferous breaks appear in the vertical sequence.

To these barren or semi-barren beds the term zonule cannot be applied, even if they are mere areal continuations of strata which do form zonules. We would not assign them a special term, however, but rather would refer to them as "beds" or "member" as the case might be.[10] Such designations are sufficiently precise for sections and descriptions, and use of them makes it possible to restrict "zonule" according to the definition—which seems necessary if it is to retain significance.

SUMMARY

Under the term faunule, Williams included two major but distinct concepts: one of a collection precisely made and labeled, the other of an organic assemblage in close relationship to its environment. In this paper the former of these, as an interpretation of faunule, is rejected, since it is of slight use, is virtually synonymous with "collection," and is out of keep-

10 Here we differ from C. H. Belanski, who uses such terms as 'dolomite zonule' (This journal, vol. 10, p. 348, 1927). This portion of our paper was written too late for Mr. Belanski to examine it in preparation of his manuscript, but his present opinion agrees with ours.

ing with many of Williams' own applications of the term. The latter concept, however, is accepted with but slight modification, and is made the basis for a re-definition of the term faunule: not merely because it is the one first stated by Williams, but because it possesses real value in biostratigraphy, and agrees with Williams' more important applications of his term.

A new term, zonule, is proposed for the strata containing a faunule, and some general suggestions are offered concerning its use and restrictions.

THE MISSOURI ARTEMISIAS

BENJAMIN FRANKLIN BUSH

In the study of the few species of ARTEMISIA in this paper, I have experienced more difficulty than I ever encountered in the study of any group of species. Judging by the names given to the specimens by collectors, my own included, it appears that few persons understand or know the species.

I was led to make an examination and study of the Missouri species, by finding a patch of some species of *Artemisia*, near the mouth of the Kaw River in 1926, the stems of which were somewhat suffrutescent, the branches of the season and the flowering branches, springing from the old stems of the previous year or years.

No species of *Artemisia* being known to me for Missouri having this suffrutescent character, I was undecided as to whether it just happened that this patch only, showed this woody character, or if it was a species of the West, that had become introduced at this particular place, there being no doubt that it was introduced.

In looking through the lists of Missouri plants and consulting authorities on the genus *Artemisia*, I noted some very interesting things, and these I will deal with further on in this paper. It is very apparent that very few of those who published lists of Missouri plants knew the species of *Artemisia*, and as I proceeded to consult the authorities, it became very apparent to me that they differed very widely from each other in their views and conceptions of the species, and the ranges of them.

The first account of the species of *Artemisia* found in Missouri that I have found, is in Torrey and Gray (18), where six species are cited for Missouri; but at that time the term Missouri meant anywhere North of Louisiana, north to Canada and Montana; following Torrey & Gray is Pech (12), who lists *A. canadensis* in his catalogue for Louisiana, Missouri; the next list published of Missouri species, important in point

of the number of species listed, is Tracy's Catalogue (19), in which eight species of *Artemisia* are listed for Missouri, three of which cited from previously published lists or floras; the last important list published so far as number of species is concerned, is Mackenzie and Bush (10), in which eight species of *Artemisia* are described for Jackson County, Missouri, and strangely enough, all correctly given.

Through the courtesies of Prof. Shantz of the University of Illinois, Dr. L. H. Pammel, of the Iowa State College, Dr. Wm. R. Maxon, of the United States National Museum, Mr. Kenneth K. Mackenzie, of Maplewood, New Jersey, and Mr. Chas. C. Deam, of Bluffton, Indiana, who have loaned me much *Artemisia* material, and otherwise assisted me by the loan of literature bearing on this study, I have been enabled to prepare this paper, and I hereby return my sincere thanks for this assistance.

1. ARTEMISIA GLAUCA DRACUNCULOIDES (Pursh) n. var.

A. dracunculoides Pursh, Fl. Am. Sept. 742, 1814.

A. dracunculus Pursh, Fl. Am. Sept. 521, 1814. Not *A. Dracunculus* L. 1753

A. nutans Fraser; Pursh, Fl. Am. 742, as synonym, 1814. Not *A nutans* Willd, 1804.

A. Nuttalliana Besser; Hook. Fl. Bor. Am. *1:* 326, 1833.

TYPE LOCALITY: Upper Louisiana, now South Dakota.

Cited for Missouri by Torrey and Gray (18), Tracy [19], Hall and Clements (9), Bush (4), Mackenzie and Bush (10), Rydberg (15), Robinson and Fernald (13), Britton & Brown (2), and Gray (8), but all of these must certainly refer to *A. cernua.*

I have been unable to separate *A. dracunculoides* from *A. glauca,* of which it appears to be only a more diffuse, taller, glabrous form.

Hall and Clements (9) cite *A. dracunculoides brevifolia* and *A. dracunculoides tennifolia* for Missouri, citing Torrey and Gray (18) for their authority, but Torrey and Gray did not cite these two varieties for Missouri, Hall and Clements being mistaken in so reading Torrey & Gray.

The citation in Britton & Brown (2) and Rydberg [15] are based on specimens collected by me at Sheffield, Missouri, No. 3961, and as they were certainly introduced plants, they may have been brought in by trains from the Northwest.

SPECIMENS EXAMINED:

MISSOURI: Sheffield, *Bush* 3961, June 13, 1906, M. Herb.

Typical *glauca* and the larger, diffuse, more glabrous form that has been taken to be *A. dracunculoides*, range much farther north and northwest of Missouri. Hall and Clements (9) cite thirteen species and varieties under *A. glauca*, or rather *A. Dracunculus*, which would indicate that *glauca* is a very polymorphous species.

2. ARTEMISIA GLAUCA CERNUA (Nutt.) n. var.
A. cernua Nutt, Gen *2:* 142. 1818.

TYPE LOCALITY: Saint Louis, Missouri.

Cited for Missouri by Rydberg (15) who segregates it from *A. dracunculoides* by the more diffuse habit, and nodding tips of the flowering branches. The only reason I have for retaining this as a variety of *A glauca*, is that it is farther away from *glauca* than is *A. dracunculoides*, and appears to have a slightly different range.

As long as it can be distinguished in the field and the herbarium it should be designated by name.

Britton [1], Britton & Brown (2) and Robinson and Fernald (13) do not recognize this variety for the Manual Range, although the type was collected near Saint Louis, Missouri.

SPECIMENS EXAMINED:

MISSOURI: Dodson, *Mackenzie*, September 26, 1897, as *A. dracunculoides*, I. S. C. Herb.; Dodson, *Mackenzie*, September 26, 1897, as *A. dracunculoides*, U.S.N.M. Herb, 318357; Lees Summit, *Mackenzie*, 408, September 9, 1901, as *A. dracunculoides*, D. Herb.; Dodson, *Mackenzie*, September 26, 1897, as *A. dracunculoides*, M. Herb.; Lees Summit, *Mackenzie* 408, September 9, 1901, M. Herb.; Clark County, *Mead*, date not given, Gray Herb.

ILLINOIS: Lee County, *Brendel*, date not given, as *A. dra-*

cunculoides, U. of Ill. Herb.; Fountaindale, *Bebb*, date not given, Gray Herb.

NEBRASKA: Omaha, *Eastman, October* 1, 1915, as *A. dracunculoides*, U. of Ill. Herb.

NORTH DAKOTA: Pleasant Lake, *Lunell* 316, July 28, 1912, and September 2, 1912, both on one sheet, as *A. dracunculoides*, U. of Ill Herb.; Dunsiette, *Lunell*, July 2, 1912, as *A. dracunculoides*, D. Herb.

CANADA: *Lethbridge*, Alberta, *Macoun* 10959, August 7, 1895, as *A. dracunculoides*, U. S. N. M. Herb. 389197.

NEW MEXICO: Organ Mountains, *Wooten*, September 17, 1893, as *A. dracunculoides*, U. of Ill. Herb.

IOWA: Plymouth County, *Brown*, October 1, 1902, as *A. dracunculoides*, I. S. C. Herb; Clear Lake, *Cratty*, August 9, 1918, as *A. dracunculoides*, I. S. C. Herb.; Fayette, *Post*, October 31, 1896, as *A. dracunculoides*, I.S.C. Herb.; Charles City, *Tuttle*, September 10, 1918, as *A. dracunculoides*, I.S.C. Herb.; Rock Rapids, *Pammel*, September 14, 1922, as *A. dracunculoides*, I.S.C. Herb.; Clear Lake, *Pammel*, October 25, 1919, as *A. dracunculoides*, I.S.C. Herb.; Mason City, *Pammel* and *McNider* 1084, date not given, as *A. dracunculoides*, I.S.C. Herb.; Spirit Lake, *Pammel*, August 28, 1918, as *A. dracunculoides*, I.S.C. Herb.; Sioux City, *Pammel*, August 30, 1895, as *A. canadensis*, I.S.C. Herb.; Charles City, *Pammel, September*, 1919, as *A. dracunculoides*, I.S.C. Herb.; Rock Rapids, *Pammel*, August 28, 1918, as *A. dracunculoides*, I.S. C. Herb.; Winnesheik, *Fitzpatrick*, August 14, 1899, as *A. dracunculoides*, I.S.C. Herb.; Des Moines, *Pammel* 1277, July 14, 1897, as *A. dracunculoides*, Gray Herb.; Muscatine, *Mackenzie* 549, September 1, 1893, M. Herb.

SOUTH DAKOTA: Opposite Hawarden, Iowa, *Pammel*, Aug. 29, 1895, as *A. dracunculoides*, I.S.C. Herb.

3. ARTEMISIA CAUDATA Michx. Fl. Bor. Am *2:* VBT. 1803.

A. variabilis americana Besser, Bull. Soc. Nat. Mosc. *8:* 24. 1835.

A. Lewisii T. & G. Fl. N. Am *2:* 417. 1843, excluding synonymy, which seems to have been founded on several different species, one of which was *A. caudata*.

A. campestris caudata (Michx.) Hall and Clements, The N. Am. Species of *Artemisia*, 122. 1923.

TYPE LOCALITY: Banks of the Missouri River, near Saint Louis, Mo.

Hall and Clements (9) place this species as a variety under *A. campestris*, which is a low, stiff, perennial (or even shrubby?) species of the Mediterranean Region, but it seems to me best to keep it distinct on account of its biennial character and tall stature, often over 15 decimeters high, rarely under 6 decimeters, while *A. campestris* is only 1 to 6 decimeters high, according to Clements and Hall.

Cited for Missouri by Torrey and Gray (18), Rydberg (15), Hall and clements (9), Egzert (7), Tracy (19) and Shepard (16).

SPECIMENS EXAMINED:

MISSOURI: Monteer, *Bush* 3599, August 8, 1905, U.S.N.M. Herb. 492078; Monteer, *Palmer* 19294, October 5, 1920, P. Herb.; Monteer, *Bush* 3595, October 8, 1905, M. Herb.; Monteer, *Bush* 201, July 27, 1899 M. Herb.

MICHIGAN: Burt Lake, *Ehlers* 1250, August 22, 1920, U. of Ill. Herb.; Big Stone Bay, *Gates* 9890, August 19, 1916, U. of Ill Herb.

ILLINOIS: Peoria, *McDonald*, August, 1887, U. of Ill. Herb.; Peoria, *Brendel*, date not given. U. of Ill. Herb.; Peoria, *McDonald*, August, 1901 U. of Ill. Herb.; Peoria, *McDonald*, September, 1901, U. of Ill Herb.; Savanna, *Waite*, May, 1887, U. of Ill. Herb.; Algonquin, *Nason*, date not given, U. of Ill. Herb.; no locality given, *Brendel*, date not given, U. of Ill. Herb.

KANSAS: Meade County, *Carleton* 528, September, 1891, U. of Ill Herb.; Leeds, *Lunell*, September 14, 1901, U. of Ill. Herb.; Butte, *Lunell*, August 5, 1906, M. Herb.

MA[illegible]: Old Orchard, *Knight*, August 24, 1905 U. of Ill. Herb.; Old Orchard, *Knight*, August 24, 1905, M. Herb.

NEW YORK: Rochester, *Baxter*, September, 1910, as *A. canadensis*, U. of Ill. Herb.

MASSACHUSETTS: Lynn Beach, *Summers*, August 17, 1887 U. S. N. M. Herb. 295315; Reserve, *Forbes*, August 16, 1902,

U. of Ill Herb.; Revere, *Forbes*, October 5, 1902, U. of Ill Herb.; Revere, *Forbes*, September 20, 1902, U. of Ill. Herb.

MINNESOTA: Saint Paul, *Seymour*, August 21, 1884, U. of Ill. Herb.; Crookston, *Westley*, September, 1918, U. of Ill Herb.

INDIANA: Pine, *Chase* 579, September 1, 1897, U. of Ill. Herb.; Indiana Harbor, *Deam* 5272, August 30, 1908, M. Herb.

OKLAHOMA: Shattuck, *Stevens* 2916½, October 11, 1913, U. of Ill Herb.; Arkansas, *Bush* 533, September 24, 1895, M. Herb.

WISCONSIN: Alma, *Palmer* 28516, September 9, 1925, as *A. canadensis*, P. Herb.; Alma, *Palmer* 28516, September 9, 1925, as *A. dracunculoides*, P. Herb.; Madison, *Cheney*, September 1, 1893, U. of Ill. Herb.; Reine, *Davis*, September 21, 1878, U. of Ill Herb.

IOWA: Waterville, *Pammel*, August 23, 1920, I.S.C.Herb.; Granite, *Pammel*, August 28, 1920, I.S.C., Herb.; Harlantown, *Pammel*, September 20, 1923, I.S.C. Herb.; Charles City, *Pammel*, and *Sherman* 3860, September 20, 1902, I.S.C. Herb.; Charles City ,*Pammel* and *Sherman* 3860, September 20, 1902, I.S.C. Herb.; Clear Lake, *Pammel* and *Naylor* 520, September 1, 1925, I.S.C. Herb.; Clear Lake, *Pammel*, September 12, 1894, I.S.C. Herb.; Cherokee, *Pammel*, September 5, 1920, I.S.C. Herb.; Rock Rapids, *Pammel*, August 28, 1918, I.S.C. Herb.; Chickasaw, *Spiker*, month not given, 1925, I.S.C. Herb.; Mason City , *Pammel*, September 20, 1923, I.S.C. Herb.; Clarion, *Hayden*, July, 1925, I.S.C. Herb.; Delaware County, *Pammel*, August 23, 1920, I.S.C. Herb.; no locality given, Northeast Iowa, *Goddard*, August 12, 1895, I.S.C. Herb.; South High Lake, *Wolden*, August 11, 1922, I.S.C. Herb.; McGregor, *Pammel* 689, August 21, 1925, I.S.C. Herb.; Fayette, *Fink*, August 27, 1894, I.S.C. Herb.; McGregon, *Hayden*, September, 1919 I.S.C. Herb.; Decorah County, collector not given, August 7, 1881, I.S.C. Herb.; Jackson County, *Fitzpatrick*, August 19, 1900, U. of Ill. Herb.; Muscatine, *Mackenzie* 533, September 24, 1895, M. Herb.

NEW JERSEY: South Amboy, *Mackenzie* 1144, October 16. 1908, M. Herb.

VERMONT: Smuggler's Notch, *Eggleston*, July 10, 1894, M. Herb.

COLORADO: Breckenridge, *Mackenzie* 294, August, 1901. M. Herb.

4. (ARTEMISIA BOREALIS CANADENSIS (Michx.) n. var.

A. canadensis Michx. Fl. Bor. Am. *2*: 129, 1803.

A. peucedanifolia Juss.; Besser, Bull. Soc. Nat. Mosc. *8*: 91, 1835.

TYPE LOCALITY: Hudson Bay.

Cited for Missouri by Torrey and Gray (18), Peck (12), and Tracy (19), but these evidently refer to *A. caudata*, which is commonly mistaken for *A. canadensis*. As I now understand *A. canadensis*, it is a low, strongly cespitose perennial of the northern regions, and does not get so far South as Missouri.

5. ARTEMISIA FRIGIDA Willd. Sp. Pl. *3*: 1838, 1804.

A. sericea Nutt Gen. *2*: 143, 1818. Not *A. sericea* Weber, 1778.

TYPE LOCALITY: Eastern Siberia.

Cited for Missouri by Torrey and Gray (18) and Tracy (19), but up to 1900 no specimens of this species were known to me from the State, and all that I have any knowledge of are chance introductions along railroads and in waste places.

SPECIMENS EXAMINED:

MISSOURI: Sheffield, *Bush* 8409, September 17, 1916, U. S. N. M. Heb. 1088940, as *A. Carruthii*.

CANADA: Point Edward, Ontario. *Dodge* 265, August 11, 1911, M. Herb.; Point Edward, Ontario, *Dodge* 266, July 11, 1911, M. Herb.; Point Edward, Ontario, *Dodge* 267, July 5, 1910 M. Herb.

COLORADO: Pitkin County, *Mann*, July 20 to July 30, 1900, M. Herb; Breckenridge, *Mackenzie* 114, August, 1901, M. Herb.

MONTANA: Butte, *Lunell*, August 26, 1906. M. Herb.; Polson, *Umbach*, August 19, 1907, M. Herb.

WYOMING: Madison Canon, *Nelson* 6867, August 30, 1899, M. Herb.; Daramie, *Nelson* 6867, September 16, 1899, M. Herb.; Laramie, *Nelson* 8163, September 5, 1900, M. Herb.

MINNESOTA: Minneapolis, *Aiton*, September 11, year not given, M. Herb.

6. ARTEMISIA BIENNIS Willd. Phytogr. 11. 1794.

TYPE LOCALITY: "New Zealand."

Cited for Missouri by Torrey and Gray (18), Eggert (7), Bush (3), Tracy (19), Mackenzie and Bush (10), Britton and Brown (2), Hall and Clements (9), Robinson and Fernald (13), Gray (8), and Small (17).

SPECIMENS EXAMINED:

MISSOURI: Courtney, *Bush*, 7784, September 13, 1916, U. S.N.M. Herb.; Sheffield, *Bush* 3300, August 30, 1905, U.S.N. M. Herb.; Thornton, *Mackenzie* 375, October 2, 1898, M. Herb.; Sheffeld, *Mackenzie*, October 31, 1897, M. Herb.

ILLINOIS: No locality given, *Welsch*, date not given, as *A. caudata*, U. of Ill. Herb.

INDIANA: Montpelier, *Deam* 640, September 2, 1905, M. Herb.

IOWA: Osage, *Tuttle*, month not given, 1916, I.S.C. Herb.; McCallsburg, *Pickford* and *Guthrie*, September 24, 1924, I. S.C. Herb.; Des Moines, *Carver*, September, 1925, I.S.S. Herb.; Decatur County, *Anderson*, September 29, 1900, I.S. C. Herb.; Boone, *Pammel*, month not given, 1902, I.S.C. Herb.; Chickasaw County, *Spiker*, month not given, 1925, I. S.C. Herb.; Woodbury County, *Burns*, month not given, 1902, I.S.C. Herb.; Granite, *Pammel*, August 28, 1920, I.S.C. Herb.; Muscatine, *Mackenzie* 346, October 20, 1892, M. Herb.

COLORADO: Breckenridge, *Mackenzie* 236, 1901, M. Herb.

NORTH DAKOTA: Leeds, *Lunell*, September 14, 1901, M. Herb.

WYOMING: Laramie, *Nelson* 8164, August 30, 1900, M. Herb.

MAINE: Bangor, *Knight*, September 24, 1905, M. Herb.

7. ARTEMISIA ANNUA L. Sp. Pl. 847. 1753.

TYPE LOCALITY: Siberia.

Cited for Missouri by Daniels (6), Mackenzie and Bush (10), Palmer (11), Bush (4), Tracy (19), and Hall and Clements (9).

SPECIMENS EXAMINED:

MICHIGAN: Detroit, *Billington* 132, September 19, 1916, M. Herb.

IOWA: Decatur County, *Fitzpatrick*, September 28, 1898, I.S.C. Herb.; Mount Pleasant, *Jacques*, month not given, 1918, I.S.C. Herb.; Decatur County, *Anderson*, September 17, 1904, I.S.C. Herb.; Ottumwa, *Pammel*, October 5, 1923, I.S.C., Herb.; Newton, *Pammel* 540, September 8, 1925, I.S.C. Herb.; Keosauqua, *Pammel* and *Reis* 457, September 10, 1925, I.S.C. Herb.; Keosauqua, *Secor*, October, 1925, I.S.C. Herb.; Logan, *Heterich*, October 3, 1923, I.S.C. Herb.; Mount Pleasant, *Pammel*, October 3, 1923, I.S.C. Herb.; Muscatine, *Mackenzie* 347, October 1, 1893, M. Herb.; Muscatine, *Mackenzie* 347, October 1, 1893, M. Herb.

8. (ARTEMISIA VULGARIS L. Sp. Pl. 848. 1753.)

TYPE LOCALITY: Europe.

Cited for Missouri by Tracy (19), who says it is common westward, but I can not imagine what Tracy had in mind when he wrote that, as *A. vulgaris is* not common anywhere in Missouri, and is only found occasionally where trash from gardens has been dumped. Bush (4) reported this for Jackson County, Missouri, but the specimens prove to be *A. ludoviciana*.

9. (ARTEMISIA MEXICANA Willd.; Spreng, Syst. *3*: 490, 1826.)

A. vulgaris mexicana (Willd.) T. & G. Fl. N. Am. *2*: 421. 1843.

TYPE LOCALITY: Mexico.

Cited for Missouri by Britton & Brown (2), Hall and Clements (9), citing Bush 412, Palmer (11), and Mackenzie

and Bush (10), but it is very evident that all these refer to *A. ludoviciana Lindheimeriana.*

10. ARTEMISIA LUDOVICIANA Nutt. Gen. *2*: 143. 1818.

A. vulgaris ludoviciana (Nutt.) Hall and Clements, The N. Am. species of *Artemisia*, 76, 1923.

TYPE LOCALITY: Banks of the Mississippi, near Saint Louis, Missouri.

Cited for Missouri by Torrey and Gray (18), Tracy (19), Britton (1), Britton & Brown (2), Rydberg (14), Bush (4), as *A. vulgaris*, Palmer (11), Mackenzie and Bush (10), and Rydberg (15).

SPECIMENS EXAMINED:

MISSOURI: Greenwood, *Bush* 2906, October 28, 1915, U. of Ill. Herb.; Dodson, *Bush* 7844, September 27, 1915, U.S.N.M. Herb.; 1088909; Springfield, *Standley* 8637, October 10, 1911, U.S.N.M. Herb. 687578; Courtney, *Bush* 6509, October 10, 1911, U.S.N.M. Herb. 673598, as *A. vulgaris;* Prosperity Junction, *Eggleston*, 12086, September 30, and October 1, 1915, U.S.N.M. Herb. 644178; Lees Summit, *Mackenzie* 424, September 9, 1901, D. Herb.; Joplin, *Palmer* 18752, August 17; 1920, P. Herb.; Webb City, *Palmer*, 17106, October 3, 1919, P. Herb.; Oronogo, *Palmer* 23916, Sept. 28, 1923, P. Herb.; Lees Summit, *Mackenzie* 424, September 4, 1901, M. Herb.; Dodson, Mackenzie, September 19, 1897, M. Herb.; Dodson, *Mackenzie* 596, October 8, 1901. M. Herb.

ILLINOIS: Chicago, *Chase*, September 22, 1896, U. of Ill. Herb.

OKLAHOMA: Cherokee Outlet, *Carleton*, September 2, 1891, U. of Ill. Herb.; Sapulpa, *Bush* 1320, September 28, 1895, M. Herb.

INDIANA: Plymouth, *Deam* 34761, September 14, 1921, D. Herb.

TEXAS: Tarrant County, *Ruth* 320, U. of Ill. Herb.

WYOMING: Mammoth Hot Springs, *Dewart*, June, 1889, U. of Ill. Herb.

IOWA: Wall Lake, *Pammel*, September 21, 1923, I. S. C. Herb.

KANSAS: Wichita, *Carleton*, September 15, 1888, U. of Ill. Herb.; Wichita, *Carleton* 142, September 15, 1888, U. of Ill. Herb.; Wyandotte, *Mackenzie*, October 20, 1896, M. Herb.

11. ARTEMISIA LUDOVICIANA LINDHEIMERIANA (Scheele) n. comb.

A. vulgaris americana Besser, Linnaea *15*: 105, in part, 1841.

A. cuneifolia Scheele, Linnaea *22*: 162. 1849, not *A. cuneifolia*, DC. 1837.

A. Lindheimeriana Scheele, Linnaea *22*: 163. 1849.

A. mexicana Britton & Brown, Ill Flora *3*: 539. 1913. Not *A. mexicana* Willd. 1826.

TYPE LOCALITY: Cibolo River, New Braunfels, Texas.

Cited for Missouri by Britton & Brown (2), as *A. mexicana*, Mackenzie and Bush (10), as *A. mexicana*, Hall and Clements (9), as *A. mexicana*, Palmer (11), as *A. mexicana*, and Rydberg (15).

SPECIMENS EXAMINED:

MISSOURI: Raytown, *Mackenzie*, September 19, 1897, M. Herb.; Lees Summit, *Mackenzie*, July 6, 1900, M. Herb.; Lees Summit, *Mackenzie*, July 6, 1900, M. Herb.; Dodson, *Mackenzie*, September 26, 1897, M. Herb.; Rayton, *Mackenzie*, September 19, 1897, I.S.C. Herb.; Dodson, *Mackenzie*, September 26, 1897, I.S.C. Herb.; Dodson, *Bush* 7844, September 27, 1915, U. of Ill. Herb.; Greenwood,, *Bush* 4121, September 19, 1906, U.S.N.M. Herb.; Kansas City, *Bush* 11051, 11051-A, 11052 and 11052-A, September 21, 1926; Greenwood, *Bush* 4121, September 19, 1906, M. Herb.; Greenwood, *Bush* 4121, September 19, 1906, M. Herb.; Webb City, *Palmer* 16244, August 31, 1919, P. Herb.

12. *Artemisia gnaphalodes* Nutt. Gen. *2*: 143. 1818.

A. ludoviciana gnaphalodes (Nutt.) T. & G. Fl. N. Am. *2*: 420. 1843.

A. vulgaris gnaphalodes (Nutt.) O. Kuntze, Rev. Gen. Pl. 309. 1891.

A. rhizomata A. Nelson, Bull. Torr. Club *27*: 34, in part, 1900.

TYPE LOCALITY: Green Bay, Wisconsin.

Cited from Missouri by Torrey and Gray (18), Mackenzie and Bush (10), Britton & Brown (2), Rydberg (15), Hall and Clements (9), and Bush (5).

SPECIMENS EXAMINED:

MISSOURI: Sibley, *Mackenzie*, 564, October 2, 1901, D. Herb.; Courtney, *Bush* 5858, July 2, 1909, U.S.N.M. Herb. 648069, Lees Summit, *Mackenzie*, July 6, 1900, M. Herb.; Harlem, *Mackenzie*, July 23, 1899, M. Herb.; Harlem, *Mackenzie*, July 23, 1899 ,M. Herb.; Harlem, *Mackenzie*, July 12, 1897, M. Herb.; Sibley, *Mackenzie* 564, October 2, 1901, M. Herb.

INDIANA: Rochester, *Deam* 39243, August 2, 1923, D. Herb.

WYOMING: Laramie, *Pammel* 1952, August 7, 1901, D. Herb.

IDAHO: Sand Point, *Umbach*, August 24, 1901, M. Herb.

NORTH DAKOTA: Leeds, *Lunell*, September 14, 1901, D. Herb.; Bismarck, *Seymour*, August 28, 1884, U. of Ill. Herb.; Fargo, *Seymour*, August 28, 1884, U. of Ill. Herb.; Leeds, *Lunell*, September 25, 1905, M. Herb.; Leeds, *Lunell*, September 3, 1906, M. Herb.

KANSAS: Kansas City, *Mackenzie*, October 20, 1896, I. S.C. Herb.; Wichita, *Andrews*, date not given, I.S.C. Herb.; Rockport, *Bartholomew*, September 6, 1891, U. of Ill. Herb.

MONTANA: Butte, *Lunell*, August 26, 1906, M. Herb.

ILLINOIS: St. Clair County, collector and date not given, Brendel Herbarium, U. of Ill. Herb.; Chicago, *Lansing*, September 9, 1906, U. of Ill. Herb.; Savanna, *Clinton*, August 28, 1894, U. of Ill. Herb.; Fountaindale, *Bebb*, month not given, 1871, U. of Ill. Herb.

OKLAHOMA: Kenton, *Stevens* 450, May 13, 1913, U. of Ill. Herb.; Alva, *Stevens* 2869, October 1, 1913, U. of Ill. Herb.; Hollis, *Stevens* 1118, June 21, 1913, U. of Ill. Herb.; Oklahoma City, *Stevens* 164, U. of Ill. Herb.

UTAH: Salt Lake City, *Mann*, September, 1900, M. Herb.

MINNESOTA: Sandy Lake, *Sandberg* 796, August 12, 1891, U. of Ill. Herb.; Glenwood, *Cowles* 3, June 21, 1907, U. of Ill. Herb.; Minneapolis, *Aiton*, September, year not given. U. of Ill. Herb.; no locality given, *Ward*, month not given, 1863, U. of Ill. Herb.

COLORADO: Colorado Springs, *Mulford*, August 31, 1892, U. of Ill. Herb.; Estes Park, *Clokey* 3956, September 14, 1920, U. of Ill. Herb.; Lake Eldon, *Clokey*, 3771, August 18, 1918, U. of Ill Herb.; Grand Lake, *Campbell*, July, 1896, M. Herb.; Lake Eldora, *Clokey* 3171, August 8, 1918, M. Herb ; Breckenridge, *Mackenzie* 247, August, 1901, M. Herb.

WISCONSIN: Baraboo, *True*, August 24, 1892, U. of Ill. Herb.

SASKATCHEWAN: Estevan, *Cowles* 13, June 22, 1907, U. of Ill. Herb.

MICHIGAN: Point Edward, *Dodge* 268, July 11, 1922, M. Herb.; Point Edward, *Dodge* 269, July 11, 1911, M. Herb.; Wayne County, *Chandler*, August 17, 1916, M. Herb.

IOWA: Merrill, *Holtzen*, September, 1923, I.S.C. Herb.; Strawberry Point, *Pammel*, August 9, 1923, I.S.C. Herb.; Ames, *Pammel* and *Lynch*, September 15, 1920, I.S.C. Herb.; Missouri Valley, *Pammel*, June 11, 1920, I.S.C. Herb.; Delaware County, *Pammel*, August 23, 1920, I.S.C. Herb.; Sioux City, *Pammel*, July 25, 1922, I.S.C. Herb.; Cedar Falls, *Pammel*, September 28, 1920, I.S.C. Herb.; Battle Creek, *Pammel*, July 23, 1922, I.S.C. Herb.; Chariton, *Pammel*, September 15, 1922, I.S.C. Herb.; Granite, *Pammel*, August 28, 1920, I.S.C. Herb.; High Lake, *Wolden* 712, September 14, 1922, I.S.C. Herb.; Montrose, *Luechel* 202, July 31, 1924, I.S.C. Herb.; Armstrong, *Cratty*, September 5, 1897, I.S.C. Herb.; Plymouth County, *Brown*, October 1, 1902, I.S.C. Herb.; Rock Rapids, *Pammel*, August 28, 1918, I.S.C. Herb.; Emmetsburg, *Pammel*, September 14, 1919, I.S.C. Herb.; Clear Lake, *Pammel*, September 12, 1924, I.S.C. Herb.; Hamilton, *Pammel*, October 28, 1923, I.S.C. Herb.; Pilot Mound, *Pammel*, October, 1918, I.S.C. Herb.; Decorah County, *Holway*, August 24, 1879, I.S.C. Herb.; Lake Mills, *Pammel*, August 21, 1918, I.S.C. Herb.; Spirit Lake, *Pammel*, August 28, 1918, I.S.C. Herb.; Armstrong, Pammel, July, 1902, I.S.C. Herb.; Greene,

Pammel, September 1, 1919, I.S.C. Herb.; Lake Mills, *Pammel*, August 21, 1918, I.S.S. Herb.; Ames, *Pammel*, September, 1912, I.S.C. Herb.; New Hampton, *Pammel*, 483, August 21, 1925, I.S.C. Herb.; Osceola, *Pammel*, September 27, 1924, I.S.C. Herb.; Sioux City, *Pammel*, August 30, 1895, I.S.C. Herb.; Ontario, *Hodson*, August 24 1897, I.S.C. Herb.; Charles City, *Pammel* and *Sherman* 3867, September 20, 1902, I.S.C. Herb.; Hawarden, *Pammel*, August, 1895, I.S.C. Herb.; Kelley, *Clayton* 170, July, August, 1911, I.S.C. Herb.; Kelley, *Clayton*, 28, July, August, 1911, I.S.C. Herb.; Fayette, *Fink*, August 4, 1894, I.S.C. Herb.; Fyaette, *Fink*, August 4, 1894, I.S.C. Herb.; Fayette, *Fink*, September 1892, I.S.C. Herb.; Northwest Valley, *Pammel*, August 14, 1894, I.S.C. Herb.; Cherokee, *Pammel*, September 5, 1920, I.S.C. Herb.; Cherokee, *Pammel*, September 5, 1920, I.S.C. Herb.; Dell Rapids, *Pammel*, July 29, 1922, I.S.C. Herb.; No locality given, *Goddard*, August 24, 1895, I.S.C. Herb.; Charles City, *Pammel*, September 3, 1916, I.S.C. Herb.; Frazer, collector not given, September 11, 1911, I.S.C. Herb.; Osage, *Tuttle*, August, 1913, I.S.C. Herb.; *Tuttle*, August, 1913, I.S.C. Herb.; Decatur County, *Anderson*, September 9, 1913, I.S.C. Herb.; Ames, collector not given, month not given, 1911, I.S.C. Herb.; Little Rock, *Pammel*, August 29, 1918, I.S.C. Herb.; Algona, *Watson*, September 5, 1902, I.S.C. Herb.; Ames, *Pammel*, month not given, 1907, I.S.C. Herb.; College Park, *Rolfs*, month not given, 1896, I.S.C. Herb.; Pocahontas, *Mecham*, 1917, I.S.C. Herb.; Clear Lake, *Pammel* and *Naylor* 521, September 1 1925, I.S.C. Herb.; Armstrong, *Cratty*, September, 1883, I. S.C. Herb.; Mason City, *Pammel* and *McNider* 1085, September 22, 1925, I.S.C. Herb.; Gillett Grove, *Pammel*, August 28, 1912, I.S.C. Herb.; Mason City, *Pammel*, August 21, 1894, I.S.C. Herb.; Hazelton, *Pammel* 708, August 24, 1925, I.S.C. Herb.; Muscatine, *Mackenzie*, August 17, 1893, M. Herb.

13. ARTEMISIA CARRUTHII Wood; Carruth, Trans. Kans. Acad. Sci. *5*: 51. 1877.

A. Kansana Britton; Britton & Brown, Ill. Flora *3*: 466. 1898.

A. coloradensis Osterhout, Bull. Torr. Club *27*: 506. 1900.

TYPE LOCALITY: Lawrence, Kansas.

Cited for Missouri by Britton & Brown (2), Mac*kenzie* & Bush (10), Hall and Clements (9), and Rydberg (15).

SPECIMENS EXAMINED:

MISSOURI: Sheffield, *Bush* 3333, September 14, 1905, U. S.N.M. Herb.; 607712; Sheffield, *Bush* 3333, September 14, 1905, M. Herb.; Sheffield, *Mackenzie*, July 29, 1901, M. Herb.

KANSAS: Kearney County, *Hitchcock*, August 24, 1897, M. Herb.; Winona, *Hitchcock*, May, 1895, M. Herb.

LITERATURE CITED

1. Britton, N. L., Manual of the Flora of the Northern States and Canada, 1905.
2. Britton & Brown, Illustrated Flora *3*: 1898.
3. Bush, B. F., Flora of Jackson County, Missouri, 1882.
4. Bush, B. F., First Supplement to the Flora of Jackson County, Missouri, 1885.
5. Bush, B. F., Notes on the Mound Flora of Atchison County, Missouri, 1895.
6. Daniels, F. P., the Flora of Columbia, Missouri and vicinity, 1907.
7. Eggert, H., Catalogue of the Plants of the vicinity of Saint Louis, Missouri, 1891.
8. Gray, A., Synoptical Flora of North America, *1*: Part 2, 1884.
9. Hall and Clements, The North American Species of Artemisia, 1923.
10. Mackenzie and Bush, Manual of the Flora of Jackson County, Missouri, 1902.
11. Palmer, E. J., Catalogue of the Plants of Jasper County, Missouri, 1916.
12. Pech, F., Catalogue of the United States Plants in the Department of Agriculture, 1866.
13. Robinson and Fernald, A. Gray, Manual, 1908.
14. Rydberg, P. A., Flora of Colorado, 1906.
15. Rydberg, P. A., North American Flora, 1916.
16. Shepard, E., Ms. List of the Plants of Missouri and Greene County, Missouri, 1893.
17. Small, J. K., Flora of the Southeastern United States, 1913.
18. Torrey and Gray, Flora of North America *2*: 1843.
19. Tracy, S. M., Catalogue of the Plants of Missouri, 1886.

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BOTANICAL GLEANINGS IN MICHIGAN V.

OLIVER ATKINS FARWELL

The season was opened on May 5th by a trip to Erie in Monroe County to look for a violet hybrid that the late Dr. Brainerd considered to be new. The small, wet depression where it was found was partially ploughed; but one or two plants were discovered at the edge of the unploughed section. The remaining part was ploughed later, so that this new hybrid station has been wiped out. Associated violets are *V. nephrophylla* and its albino and *V. fimbriatula* and its albino; while not so very far away are *V. communis* and *V. subsagittata*. In company with Prof. Ehlers, of the University of Michigan, and Mr. Billington, of Detroit, a visit was made to the *Trillium grandiflorum* fields near Farmington, May 8th. The field visited is not the one that was the basis of my paper on the variations of this species, though not far distant from it. The special object of the visit was to gather the rhizomes of the different variations for the Botanical Garden of the University. The woods have been sold and are being subdivided, which means the ultimate elimination of this station. The various variations were plentiful. We again confirmed the validity of the pink color-form by finding it here with the petals pink *in the bud*. On May 11, we found *Viola* ~~emarginata~~ *fimbriatula* very abundant in the vicinity of Wayne and Eloise. On this day we found a large number of Morels, 28 in number, in a space of four feet, the most we have ever seen at one station. This was at a subdivision called Birch Hill Park. On May 18th, in the vicinity of Washington, wild or naturalized peach, apple, and pear trees were in bloom. On June 15 we visited a Tamarack swamp near Whitmore Lake. This was visited by Mr. Gladewitz some

twenty years ago and at that time the Stemless Ladyslipper was counted by the thousands; now there is not a single specimen. It seems to have been replaced by an abundance of Poison Dogwood which was not there 20 years ago. Several colonies were found of each of the following but each colony was restricted to plants of its own category. *Pyrola Asarifolia* which has suborbicular leaves broader than long, rounded or cordate at base and pink anthers; var. *ovata* which has similar leaves but longer than broad, rounded or occasionally narrowed at base, dull or but little glossy and anthers that are partly yellow. *Unifolium bifolium* and its variety *Canadense*. Mr. Billington of Detroit took us for a trip to his home town of Tecumseh on June 21. The day turned out to be a very wet one. *Arabis glabra* and *A. Canadensis* were collected in the region where *Viola dasyneura* Greene was originally collected but nothing of the latter was discoverable, even in fruit. A visit to Ypsilanti was made June 29 with the special object of ascertaining if *Hymenophysa pubescens* and *Lepidium perfoliatum* had maintained their existence in that locality. Not a solitary sign of either one could be found. They had maintained a precarious foot hold on the railway for three or four years when improvements to the roadbed seems to have destroyed the stations for both species. They did not spread beyond the roadbed. On September 28 we botanized in the vicinity of Eames, a way station of the Grand Trunk Western in Orion Township of Oakland County. It was a wet day and we gathered in a considerable amount of rain. We came across two huge oaks lying upon the ground. These had been cut down recently, split open and cleaned of the honey that had filled their cavaties. Bees were still hovering over their devastated homes.

Where the year of collection is not expressed, it is to be understood as 1927, and the collectors as O. A. Farwell and B. Gladewitz.

Botrychium multifidum (Gmel.) Rupr., var. *intermedium* (D. C. E.) Farwell. On thinly wooded hillsides at Ortonville. The fertile fronds had withered and fallen away, leaving only the sterile. No. 8129, September 21st.

Hippochaete laevigata (A. Br.) O. A. F., var. *Eatonii*

O. A. F. Railroad banks in Ypsylanti. *Stems annual,* more or less rough to the touch; spikes obtuse or barely apiculate. No. 7279, June 29th.

Hippochaete prealta (Raf.) O. A. F., var. *intermedia* (A. A. E.) O. A. F. Somewhat similar to the above and often confused with it; but the sheaths are black, becoming ashy with a black ring above and below, the spikes are sharply pointed, the stem walls are thicker, and the stems are perennial. On grassy slopes, roadsides, etc. Stony Creek, Monroe County, No. 8084, August 17th; Eames, No. 8139, September 28th.

Hippochaete prealta (Raf.) O. A. F., var. *scabrella* (Engelm.) O. A. F. Roadsides at Ortonville. No. 8119, September 21st.

Bromus ciliatus Linn, var. *purgans* (Linn) A. Gr., subvar. *laevivaginatus* (Wieg.) Farwell. In rich woods at Eames. No. 8146, September 28th.

Panicularia laxa Scribn. Manna Grass. Much like *P. Canadensis* but with oblong, fewer-flowered spikelets. Eloise, No. 8025, July 27th. Algonac, No. 8055, August 10th.

Asperella Hystrix (Linn) Humb. Porcupine Grass. Often 5 feet in height, but usually much lower. Near Farmington Junction there is an extensive wooded area where both this and the var. *Bigeloviana* occur; each, however, has its separate section and these do not overlap in so far as our observations could determine. Eames, No. 8143, September 28th. Farmington Junction, No. 8160, October 5th.

Asperella Hystrix (Linn) Humb., var. *Bigeloviana* Fernald. In a Cedar-Tamarack swamp at Washington, No. 8047, August 3rd. Farmington Junction, No. 8159, October 5th.

Lolium perenne Linn. Rye Grass. Some of the inflorescences are branched at the basal end, branches widely spreading, giving the inflorescence an ovate outline. A tendency toward var. *ramosum* Smith. Roadsides, etc., Detroit, No. 8054, August 10th.

Lolium multiflorum Lam. Some of the inflorescences branched at the basal end; branches erect and appressed. A tendency toward var. *ramosum* Guss. Vacant lots, etc., Detroit, No. 8053, August 10th.

Stipa spartea Trin. This species, also goes by the name of Porcupine Grass. Sandy grounds and roadsides at Whitmore Lake; No. 7948, June 15th.

Panicum miliaceum Linn. Roadsides at Rochester, No. 7588, August 26th, 1925. It has been observed at Oxford and at various other places.

Panicum virgatum Linn. Low grounds, usually in moist soil. Abundant in south-eastern Michigan. Ypsilanti, No. 6323, August 9th, 1922.

Pancium virgatum Linn, var. *elongatum* Vasey. Pannicle long and narrow. Ypsilanti, No. 6340, August 9th, 1922. Dundee, No. 5300, July 15th, 1919.

Panicum virgatum Linn, var. *Cubense* Griseb. Moist, gravelly soil along railways. Ypsilanti, No. 6803½, September 12th, 1923. Ann Arbor No. 8021, July 20th.

Panicum strictum Ph. Variable in the length of its fruit and in its pubescence which varies from glabrous to pilose. The fruit is acute in the type and obtuse in the varieties, one to two lines long. Chiefly it is a species of shaded places, but the last named variety is one of sunny situations. Port Huron, No. 4970, June 3rd, 1918. Algonac, No. 5498, June 20th, 1920. Portage Lake, No. 5850, June 12th, 1921. Goodison, No. 6504, June 6th, 1923. Rochester, No. 6959, July 9th, 1924.

Panicum strictum Ph., var. *linearifolium* (Scribn.) N. Comb. (*P. linearifolium* Scribn.) Bloomfield, No. 4998, June 29th, 1918. Washington, No. 5899, June 21st, 1921. Romulus, Nos. 6158 and 6159, June 7th, 1922. Ortonville, No. 6190, June 14th, 1922. East Lansing, No. 6540, June 9th, 1923. Metamora, No. 6652, July 15th, 1923. A variation of this with glabrous sheathes may be known as subvar. *Werneri* (Scribn.) N. Comb. (*P. Werneri* Scribn.) Grand Ledge, No. 6562, June 10th, 1923.

Panicum strictum Ph., var. *perlongum* (Nash) N. Comb. (*P. perlongum* Nash). Detroit, No. 5619, August 29th, 1920. Romulus, No. 6157, June 7th, 1922. Algonac, No. 2210, June 17th, 1925.

Panicum Bicknellii Nash, var. *Bushii* (Nash) O. A. F. This variety is characterized by the pilose sheaths (Bush No.

3246). Borders of upland woods near Dearborn. No. 4532a, July 14th, 1917, and Nos. 5598 and 5601a, August 15th, 1920. Sandy fields and roadsides at Algonac; No. 5497, June 20th, 1920.

Panicum dichotomum Linn. Usually in thin woods. Detroit, No. 4533a, July 14th, 1917. Bloomfield, No. 4999, June 29th, 1918. Royal Oak, No. 5583a, August 12th, 1920.

Panicum boreale Nash. In tall grass along the borders of a Tamarack swamp near Orion. *Billington* and *Farwell*, No. 5050, July 7th, 1918.

Panicum Lindheimeri Nash, var. *fasciculatum* (Torr.) Fernald. Usually a shade plant of sparsely wooded areas. Dearborn, Nos. 4512b and 4515a, July 8th, 1917; No. 4527a, July 14th, 1917. Newport, No. 6240, July 5th, 1922. A more rigid variation of sunny fields, etc., is subvar. *pilosum* (Torr.) N. Comb. (*P. Huachuchae Ashe*). Algonac, No. 5496, June 20th, 1920. Portage Lake, No. 5841, June 12th, 1921. Washington, No. 5885, June 21st, 1921.

Panicum Lindheimeri Nash, var. *Tennesseense* (Ashe.) N. Comb. (*P. Tennesseense Ashe*). Moist grounds and borders of woods. The leaves have a conspicuously white cartilaginous margin. Portage Lake, No. 5847a, June 12th, 1921.

Panicum Lindheimeri Nash, var. *implicatam* (Scribn.) Fernald. Panicle axis long pilose, the lower branches implicate. (*P. implicatum* Scribn.) Wet meadows, etc. Dearborn, No. 4514c, July 8, 1917. Pontiac, No. 5270a. June 29th, 1919. Ypsilanti, Nos. 5275 and 5281, July 13th, 1919. Washington, No. 5894, June 21st, 1921. A variation with the axis puberulent and the lower branches slightly or not at all implicate is subvar. *meridionale* (Ashe) N. Comb. (*P. meridionale* Ashe). Sandy clearings, etc., Detroit, No. 1614b, July 13, 1900. Parkdale, No. 5028, July 4th, 1918. Royal Oak, No. 5582, May 12th, 1920. Oxford, No. 5616a, August 22nd, 1920. Portage Lake, No. 5845, June 12th, 1921. Erie, No. 6993, July 30th, 1924.

Panicum praecocius H. & C. A large stand of this species was found on dry grounds near Ann Arbor. It was in perfect condition. Fruits are 1 line long. No. 7991, June 29th.

Previously collected in Keweenaw County, No. 596½, August 16th, 1888.

Panicum Tsugetorum Nash. In sandy grounds at Royal Oak, No. 5583, August 12, 1920.

Panicum sphaerocarpon Ell. Sandy grounds. Royal Oak, No. 5584, August 12th, 1920.

Panicum macrocarpon Torr. Dry, sandy soils. Lothrop, No. 4785a, October 21st, 1917. Rockwood, No. 4951, June 16th, 1918. Orion, No. 5051, July 7th, 1918. Ypsilanti, No. 5238, June 15th, 1919. Algonac, No. 5495, June 20th, 1920. Stony Creek, Monroe County, Nos. 5826, and 5827, June 9th, 1921. Romulus, No. 6160, June 7th, 1922.

Panicum latifolium Linn. Usually in more or less rocky or sandy woods. Dearborn, No. 4532b, July 14th, 1917. Royal Oak, No. 5584b, August 12th, 1920. Romulus, No. 6161, June 7th, 1922.

Cyperus esculentus Linn. Nut grass. Moist fields and often becoming a troublesome weed. It spreads rapidly through its nut-like tubers. The typical form with spikelets 1.5 lines broad has not been observed.

Cyperus esculentus Linn, var. *leptostachyus* Boeckl. A rare variation with long, narrow spikelets, .75 to 1.5 inches long. Birmingham, No. 5214, October 13th, 1918; Detroit, No. 1698, October 2nd, 1900.

Cyperus esculentus Linn, var. *angustispicatus*, Britt. The common variation of the species in southeastern Michigan. The spikelets are slender, the widest being not more than a line wide, generally only .5 to .75 of a line wide. Detroit (Palmer Park), No. 1573, September 8th, 1897, and (Oakwood) No. 5129, September 15th, 1918; Dearborn, No. 4659, September 29th, 1917; Junior, No. 5060, July 13th, 1918; Algonac, No. 7258, October 15th, 1924; Monroe Piers and shores of Lake Erie, No. 7801, September 8th, 1926.

Stenophyllus capillaris (L.) Britt. The typical form of the species. Sandy fields. Algonac, No. 8063, August 10th.

Scleria triglomerata Mx. Nut Rush. Low grounds at Stony Creek, Monroe County. Rather plentiful, No 8083, August 17th.

Carex Crawfordii Fernald. In moist ground. Keweenaw County, No. 602, September 12th, 1887.

Carex Crawfordii Fernald, var. *vigens* Fernald. In this the inflorenscence is shortened and more crowded. Keweenaw County, No. 602a, August 12th, 1888.

Carex cristata Schw. Common and abundant throughout the state. Keweenaw County, No. 683a, September 15th, 1889. Ypsilanti, No. 683cc., July 23rd, 1891. Belle Isle, No. 683f, July 21st, 1892. Parkedale, Nos. 2787, June 30th, 1912, and 2866, July 14th, 1912. Rockwood, No. 4941, June 16th, 1918. South Rockwood, No. 5864, June 14th, 1921. Harris, Nos. 5068 and 5080, July 13th, 1918. Dearborn, Nos. 5022b, 5025e, and 5028hh, July 6th, 1918. Lakeville, No. 5315, July 20th, 1919. Almont, No. 6275a, July 19th, 1922.

Carex cristata Schw., var. *catelliformis* O. A. F. In low, moist grounds. South Rockwood, No. 5864, July 12th, 1921.

Carex cristata Schw., var. *ellipsoidalis*, O. A. F. Dearborn, No. 5022b, July 6th, 1918; Harris, No. 5080, July 13th, 1918.

Carex festucacea Schk. Spikes characterized by the prominently clavate bases. Port Huron, No. 4975a, June 23rd, 1918; Rockwood, No. 7931, June 8th.

Carex festucacea Schk., var *echinodes* (Fernald) O. A. F. This variety has the tips of the perigynia conspicuously srpeading. Trenton, No. 5784½, June 26th, 1921; Flat Rock, No. 7936, June 8th.

Carex festucacea Schk., var. *tenera* (Dew.) Carey. This variety has the spikes rounded at the base. Flat Rock, No. 7937, June 8th.

Carex brevior (Dew.) Mackenzie. In sandy but more or less moist grounds and associated with *C. cumulata.* Algonac, Nos. 3786 and 3793, July 26th, 1914, and No. 5498a, June 20th, 1920. In wet or dry grassy fields and thickets. Rockwood, No. 7935, and Flat Rock, No. 7947, June 8.

Carex brevior (Dew.) K.K.M., var. *pseudofestucacea* O. A. F. This is the *C. festucacea* of Gray's New Manuel, Mackenzie having shown that the name is untenable as used therein. Wet grassy grounds. Near Temperance, No 8004. July 13th. Also at Goodison, No. 7676, September 30th, 1925.

Carex Bicknellii Britt. In dry, sandy grounds at Fern-

dale. Previously reported as *C. alata*. *Billington & Farwell* No. 5578, August 12th, 1920.

C. straminea Willd., var. *alata* (Torr.) Bailey. On dry sterile hillsides in Keweenaw County. Mr. Mackenzie refers this to his *C. Merrit-Fernaldii*. No. 762, July 18th, 1890.

Carex cumulata (Bailey) K. K. M. In dry, yellow sand. Eloise, No. 8027, July 27. Previously I have found this carex at only three places, Algonac, Detroit, and Woodville. Detroit, No. 1870, September 9, 1904; Algonac, No. 2817, July 7th, 1912; No. 3690, June 21st, 1914; Nos. 5500a, 5500b, June 20th, 1920; Nos. 7257b, 7257c, October 15th, 1924; No. 7420½, June 17th, 1925. Undoubtedly belonging here is the Woodville collection, No. 5958, August 4th, 1921, previously reported as *C. straminea* Willd. It differs in having only three or four whitish, separated, strongly clavate-tapering spikes but the perigynia are distinctly those of this species.

Carex sparganioides Muhl., var. *lutea* O.A.F. In more or less exposed situations. Flat Rock, No. 7938, June 8th.

Carex aquatilis Wahl. Water Sedge. The typical form of this species is the variety *elatior* Bab. Similar to *C. stricta* Lam. but has larger and more club-shaped spikes of a much paler color and the leaf sheaths are not fibrillose. Near Whitmore Lake, No. 7966, June 15th. Also on Belle Isle, No. 1799, August 4th, 1903; Marl Lake, No. 4932, June 9th, 1918; Monroe Piers, No. 5481, June 3rd, 1920.

Carex aquatilis Wahl., var. *substricta* Kuken. This is the *C. aquatilis* of our manuals. Keweenaw County, No. 1676½, August 1900; Belle Isle, No. 1676¼, June 14th, 1901.

Carex aquatilis Wahl , var. *cuspidata* Laestad. This variety has very narrow ,slender spikes with scales, more or less cuspidate, longer than the perigynia. Belle Isle, No. 1709, June 4th, 1901.

Carex aquatilis Wahl., var. *virescens* Anders. In this variety the scales are shorter, often hidden, and of the same color as the perigynia so as to be scarcely discernable. Belle Isle, No. 1917, June 24th, 1905.

Carex virescens Muhl. I have found this but once in Michigan. Keweenaw County, No. 697, September 20th, 1888.

Carex virescens Muhl., var. *Swanii* Fernald. A gigantic

form; culms 35 to 45 inches in length; much exceeding the leaves; the lowest bract, often the lowest two bracts leaf-like and exceeding the culm; spikes up to 10 lines or the terminal an inch in length and up to 3 lines in thickness; the perigynia typical for this variety. Eloise, No. 8026, July 27th. The commoner form, much shorter and more slender, with leaves usually longer than the culms, and with short setaceous bracts has been collected at Detroit, No. 1376, June 22nd, 1893; Algonac, No. 2819, July 7th, 1912; No. 2819a, June 20th, 1920; No. 4227, June 22nd, 1916; Dearborn, No. 4514, July 8th, 1917.

Carex umbellata Schk. Along the tops of rocky ledges at Grand Ledge. Culms few and only an inch or so long, staminate only for the most part; leaves about 6 inches in length. This species is rare in Michigan. No. 6557, June, 10th, 1923; also Keweenaw County, No. 737, July 7th, 1890; Orion, No 737a, May 30th, 1895.

Carex umbellata Schk., var. *vicina* Dew. Culms prominent, 3 or 4 inches long with both staminate and pistillate spikes. Leaves much longer. In sandy woods near Eloise, No. 7890, May 11th. Also in Keweenaw County, No. 735, July 7th, 1890; Orion, No. 735a, May 30th, 1895.

Carex Richardsoni R. Br. A new station for this rare sedge was discovered near Rochester. It was associated with *Carex siccata* Dew. No. 7911 and *C. Pennsylvanica* Lam., No. 7912, on sandy hillsides not far from the interurban station called "Due West," No. 7910, June 1st.

Carex laxiflora Lam. In rich woods. Rockwood, No. 7926, June 8. A variety with shorter, thicker, fertile spikes is var. *gracillima* Boott. They pass gradually, one into another. Rockwood, No. 7923, June 8th. Another variety with broader leaves and the inconspicuous staminate spike hidden in the aggregated fertile ones is var. *blanda* (Dew) Boot. Rockwood, No. 7942, June 8th.

Carex riparia Curt., var. *pseudopaludosa* Schur. (*C. lacustris* Willd.) The lower-most leaves are reduced to bladeless, purple sheaths which become fibrillose. Growing along the shores of rivers, lakes, etc., always in water. Ypsilanti, No. 1167, July 18th, 1891; Detroit, No. 1167a, June 15th,

1893; Cass Lake, No. 4245, June 29th, 1916; Orion, No. 5057, July 7th, 1918; Monroe Piers, No. 5480, June 3rd, 1920.

Carex riparia Curt., var. *impressa* S. H. Wr. The lowermost sheaths are neither purple nor fibrillose and produce the normal leaf blade. Usually in places that may have water occasionally but are for the most part dry. Abundant along roadside ditches and in small depressions, from Rockwood to Flat Rock. No. 7922, June 8th. Also at Rochester, No. 4236, June 25th, 1916; Newport, No. 6227, July 5th, 1922.

Carex intumescens Rudge, var. *Fernaldii* Bailey. Associated with it were *C. intumescens* and C. *Grayi*. Rockwood, No. 7941, June 8th.

Arisaema triphyllum (L.) Torr., f. *vivide* (Engler) O.A.F. South of Washington, No. 7905, May 18th, 1927; Rockwood, No. 7934, June 8th.

Juncus Greenei Oakes & Tuckerm. This is rather scarce, but seems to be well distributed. Algonac, No. 8067, August 10th; Monroe, No. 8098, August 17th.

Juncus Dudleyi Wieg. In a Tamarack swamp near Whitmore Lake, No. 7954, June 15th; Tecumseh, No. 7977, June 21st.

Juncus tenuis Willd., var. *Billingtonii* O.A.F. Wet grounds near Temperance, No. 8002, July 13th.

Juncus tenuis Willd., var. *uniflorus* O.A.F. Wet grounds near Temperance, No. 8003, July 13th.

Juncus brachycephalus (Engelm.) Buchn. Cedar swamps at Washington. No. 8046, August 3rd.

Juncus Canadensis J. Gay. Low fields at Algonac. No. 8069, August 10th. Monroe, No. 8094, August 17th.

Juncus Torreyi Coville, f. *brevipes* Farwell. Low grounds at Newport. No. 8077, August 17th. Also f. *longipes* Farwell, at Stony Creek. No. 8082, August 17th.

Juncus brachycarpus Engelmn. Low grounds at Monroe. No. 8093, August 17th.

Juncoides pilosum (L.) Coville, var. *Michiganense* O.A.F. Near Farmington, No. 7882, May 8th, 1927; Wayne, No. 7894, May 11th.

Hemerocallis fulva Linn. Day Lily. This plant is well established in southern Michigan as an escape from cutivation.

It is seen in all sections along roadsides, on banks ,etc. Detroit, No. 1637, June 27th, 1899; Farmington, No. 5089, July 14th, 1918.

Its near relative, *H. Lilio-Asphodelus* Linn, better known as *H. flava* Linn, has not been detected. Under the International Rules, *H. flava* must give place to the older name.

Lilium ~~*umbellatum*~~ Pl. Wood Lily. At this time of the year even the fruit had fallen, leaving only the foliaceous stem. Ortonville, No. 8130, September 21st.

Unifolium bifolium (L.) Greene. Often called Lily-of-the-Valley. Tamarack swamps near Whitmore Lake, No. 7959, June 15th. In the same locality is var. *Canadense* (Desf.) O. A. F. which is entirely glabrous, No. 7958.

Trillium grandiflorum (Mx.) Salisb. Wake Robin. In rich woods near Farmington Junction, No. 7865, May 8th, 1927; near Rochester, No. 7914, June 1st. Forma *roseum* O.A.F. The petals are very large and are colored magenta to dull majenta purple. In rich woods, near Rochester, No. 7915, June 1st. The white flowers of this species usually fade to a dirty white, rarely, with a tinge of pink. Those that are rose from the start fade to a darker rose. Forma *orbiculare*, O. A. F., No. 7866. Forma *spatulatum* O. A. F., No. 7873. Variety *obovatum* (Ph.) O. A. F. The petals are small, obovate, rosepink from the first, even in the bud. No. 7869.

Trillium lirioides Raf. No. 7871. Forma *albomarginatum* O. A. F., No. 7874. Forma *giganteum* O. A. F., No. 7872. Variety *longepetiolatum* O. A. F., forma *vegetum* O. A. F., No. 7870. Forma *subsessile* N. F. Leaves and peduncle sessile or subsessile, arising directly, or nearly so, from the rhizome, otherwise like f. *variegatum* into which it passes. No. 7881.

Trillium Chandleri O. A. F., f. *foliaceum* O. A. F., No. 7876. Forma *plenum* O. A. F., No. 7880. Forma *palaceum* O. A. F., No. 7868. A herbarium specimen of each of the above was collected at the new *Trillium* field near Farmington, May 8th, 1927. Mr. Ehlers collected the rhizomes of all, and one also of *T. Chandleri* f. *subulatum* for the University Botanical Garden. This second field is much more extensive

than the first one, but does not contain as wide a variety of forms.

Smilax herbacea Linn. Carrion Flower. Leaves smooth underneath. Scarce in this district. Eames, No. 8147, September 28th.

Quercus ellipsoidalis. E. J. Hill. Yellow Oak. Much like *Q. velutina*, but the elliptical, turbinate fruit distinguishes it from that. Roadsides at Eames, No. 8138, September 28th.

Polygonum amphibium Linn. The typical, aquatic European form of this species has received the varietal name *aquatica* Leys (1761) [var. *natans Moench* (1777)]. Leaves oblong-oval, acute or obtuse, cordate, spikes, ovoid or short cylindric. Margin of leaves, smooth or hispid. Very similar to the American plant but the leaves are generally cordate and the margins hispid; in the American plant the leaves are generally rounded or tapering at base with smooth margins. The leaf of the European plant frequently has a smooth margin and that of some forms of the American frequently is more or less hispid. There seems to be no specific distinction. But according to all accounts the European type is not found in America. The terrestial type has been named var. *terrestre* Leyss. It has longer, narrower leaves, cordate but more acute, rough with a very short strigosity. The American representatives of the two above varieties are scarcely distinct, but as a matter of convenience may be maintained on the basis of the differences in the basal characters of the leaf blades, the European being cordate and the American rounded or tapering.

Variety *natans* Mx., Fl. Bor. Am. (1803) I 240. Not Moench (1777) which is var. *aquaticum*. Aquatic. Leaves narrowly oblong, tapering or round at both ends, margins smooth. Eloise, No. 8028, July 27th. This plant is typical var. *natans* floating on water with stems rooting at the bottom; it has sheaths without foliaceous borders. Some plants (No. 8028½) have stems which creep up the bank and trail over the ground. The stems on the ground send up erect branches of the usual terrestrial type, with borderless sheaths, or rarely, one or two sheaths may show a very small border. Keweenaw Co., No. 352, Sept. 4th, 1885; Detroit, No. 352b, Sept. 3rd,

1892; Lakeville No. 5322, July 28th, 1919; Drayton Plains, No. 6351, August 16th, 1922; Sclocum's Island, No. 5977, August 31st, 1921. The terrestrial form of this is very similar to the variety *terrestre*, but has the leaves rounded or tapering at base and may be maintained as distinct on that character. It will be placed under var. *natans* as subvar. *terreum* N. Subvar. Terrestrial, leaves oblong-lanceolate, acuminate, rounded or tapering at base, stigose to nearly glabrous, sheaths without foliaceous border. Mostly sterile. Sanford in Rhodora (1925) XXVII 158 credits the true var. *terrestre* of Europe to Yarmouth, Nova Scotia, but the plant probably belongs here as var. *terrestre* is sterile and could not have been found in North America unless living plants had been brought over and transplanted, which is very unlikely. Probably belonging here also are *Persicaria abscissa & homalostachya* Greene; *Polygonum amphibium* f. *terrestre* Blake. Eloise, No. 8029, July 27th. Near No. 8028, mentioned above. Perhaps derived from the same source but direct connection was not traced. Some of the stems had the lower leaves of the aquatic type and the upper of the terrestrial. Also, most of the sheaths were borderless, but a few had borders. One plant collected had but one bordered sheath on the middle of the stem. The occasional foliaceous border of the sheath shows the close connection of this with the variety *marginatum* into which it problably passes. Previously collected at Algonac, No. 3895, September 13th, 1914; Detroit, No. 5151, Sept. 20th, 1918; Hamburg, No. 6758, Sept. 5th, 1923; Sylvan Lake, No. 7279, October 22nd, 1924; Commerce, No. 7392, June 3rd, 1925; Whitmore Lake, No. 8017, July 20th.

Variety *marginatum* Farwell. Similar to var. *natans* Mx., but the sheaths have foliaceous borders. Aquatic. Rather scarce. Keweenaw Co., No. 351, Sept. 4th, 1885; Detroit, No. 351a, August 12th, 1892; Lakeville, No. 351b, September 2nd, 1901. The terrestrial form of this is common and abundant. It may be placed under var. *marginatum* as subvar. *Hartwrightii* (A. Gr.) N. Comb. (*Polygonum Hartwrightii* A. Gr., Proc. Am. Acad. (1870) VIII 294). Bloomfield, No. 5002, June 29th, 1918; Detroit, No. 5666, Sept. 7th, 1920; Lake Linden, No. 5963, Augsut 10th, 1921; Slocum's Island,

No. 5987, August 31st, 1921; Commerce, No. 7393. June 3rd, 1925; Goodrich, No. 7649, Sept. 23rd, 1925; Parkedale, No. 3812, July 30th, 1914. A similar terrestrial form but with more shaggy pubescence may be called subvar. *hirtuosum* (Farwell) N. Comb. (*P. amphibium* var. *marginatum* f. *hirtuosum* Farwell, Pap. Mich. Acad. Sci. (1923) I 93.) Detroit, No. 5620, August 29th, 1920; Slocum's Island, No. 5978, August 31st, 1921; Flat Rock, No. 7458, July 1st, 1925. In the various forms dealt with above, we have had groups with glabrous spikes and with leaves of an oblong type, those of the aquatic forms being glabrous and those of the terrestrial being pubescent. In the following the spikes are glandular and the leaves are of an ovate type, otherwise not differing from the above.

Polygonum amphibium Linn, var. *coccineum* (Muhl.) Farwell. The type of Muhlenberg's *Polygonum coccineum* is the aquatic form, Willdenow's "*A aquaticum.*" But this varietal name is in use for the typical form of the species so it can not be used here. Aquatic; leaves ovate, lanceolate, cordate; peduncles glandular. Sheathes not bordered. Whitmore Lake, No. 8011, July 20th. Previously collected at Detroit, No. 352a, September 3rd, 1892. The terrestrial form may be known as subvar. *emersum* (Mx.) N. Comb. [*Polygonum amphibium* var. *emersum* Mx., l. c.; *P. amphibium* var. *natans f. emersum* (Mx.) Farwell, Ann. Rept. Mich. Acad. Sci. (1920) XXI 365. *P. coccineum f. terrestre* (Willd.) Sanford, Rhodora (1925) XXVII 162]. Detroit, No. 1452, October 19th, 1893; Grosse Isle, No. 1452a, August 14th, 1909; Detroit (Oakwood), No. 4110, September 23rd, 1915; Birmingham, No. 5211, October 13th, 1918; Algonac, No. 5500½, June 20th, 1920; Detroit No. 5621, August 29th, 1920; La Salle, No. 5758, May 19th, 1921; and No. 6039, September 21st, 1921; Cass Lake, No. 7222, October 1st, 1924. Another form that combines both acquatic and terrestrial characters may be placed as subvar. *rigidulum* (Sheld.) N. Comb. (*Polygonum rigidulum* Sheld. Minn. Bot. Studies (1894) I 14.) In the early spring truly aquatic and floating in shallow water. After the water has dried up, the stems become erect and send out new branches which bear characteristic terrestrial foliage so

that late summer and autumn plants are bearing both aquatic and terrestrial types of leaves. Dearborn Nos. 7403, June 10th, 1925, and 7403a August 5th, 1925

Polygonum Lapathifolium Linn, var. *Salicifolium*, Sibth. Persicaria. In the typical form the flowers are rose. Low grounds at Lake Linden, No. 8111, September 2nd, 1925. A variation having white and rose flowers variously mixed or having some spikes with all the flowers white may be known as forma *pallidum* N. F. Low grounds at Lake Linden, No. 8112, September 2nd, 1925.

Polygonum Lapathifolium Linn, var. *incanum* (Roth) Koch. Green flowers and fruits larger than in those of the preceding forms; all leaves white tomentose beneath except the uppermost in luxurient specimens which become glabrate or glabrous. With the preceding forms, No. 8113. The variety *tomentosum* (Schrank) Schuster differs in having greenish-white or white flowers instead of green; in being more robust; and in having only the lowermost leaves tomentose beneath. Farmington Junction, No. 8157, October 5th.

Chenopodium Ambrosioides Linn. Spikes densely flowered and copiously leafy. Detroit, No. 5186, September 13th, 1918, and 8163, October 12th, 1927.

Chenopodium Ambrosioides Linn, var. *anthelminticum* (Linn) A Gr. Spikes more slender, leafless. Detroit No. 8162, October 12th, 1927.

Silene antirrhina L., f. *bicolor* N. F. Sleepy Catchfly. Flowers white ventrally, pink dorsally. Open in cloudy, dark weather. The typical form of the species is said to open for a short time, only during sunshiny weather. Plentiful at Flat Rock, No. 7945, June 8th.

Melandryum album (Mill.) Garcke. White Campion. This is a common weed in south-eastern Michigan. The flowers are white or tinged with pink, open around 5 or 6 o'clock in the evening and remain open until 9 or 10 o'clock the next morning. This species is said to have teeth of capsule erect but in Michigan plants they are recurved as in *M. dioica* (L.) Schinz & Thell. Styles five or more. Carpels usually five, two, often three, toothed. Whitmore Lake, No. 8006, July 20th. Washington, No. 8036, August 3rd. Algonac, No. 8060,

August 10th. Previously it has been collected at Detroit, No. 1462, June 22nd, 1894; Ypsilanti, No. 3811, July 30th, 1914; Parkedale, No. 3870, September 7th, 1914; Royal Oak, No. 5587d, August 12th, 1920; Ortonville, No. 6178, June 14th, 1922; Utica, No. 6298, August 2nd, 1922; Farmington Junction, No. 7630, September 9th, 1925.

Melandrium noctiflorum (L.) Fries. Catchfly. Similar to the above but the styles and carpels are three. Flowers white or pink, opening and closing as noted for the preceding species. Lake Linden, No. 8101, August 24th, 1927. Previously collected in Keweenaw County, No. 251, July 5th, 1885. Ypsilanti, No. 251a, June 25th, 1891. Detroit, No. 251b, September 16th, 1892 and No. 2497, September 7th, 1911. Parkdale, No. 2922, July 28th, 1912. Anchorville, No. 6408, September 27th, 1922.

Ranunculus carecitorum Greene. This Swamp Buttercup usually is found on low, wet, more or less wooded and swampy grounds through which a small stream winds its devious way. It probably is the largest (two and one quarter inches across) flowered species of this group. The petals are oblong to round, obovate, some fully an inch long. The large, deltoid root leaves are ten or eleven inches wide and long. More or less rough pubescent. Due West, a stop station on the interurban line, No. 7915, June 1st.

Anemone cylindrica A. Gr., f. *albida* O. A. F. Sepals thin and white, no tinge of greenish. Banks and hillsides at Ypsilanti, No. 7983, June 29th.

Hepatica acutiloba DC., var. *variegata* N. Var. The leaves are mottled dark green and light green. Analogous to the next variety described but have not seen the brown marking in this. Frequently met with along with the typical form of the species. Rockwood, No. 7932, June 8th.

Hepatica Americana (DC.) Ker., var. *maculata* N. Var. The leaves are beautifully mottled brown and green. In a wet open piece of woods near Wayne. Quite plentiful. The normal green leaved form, the specific type, was not seen. The mottling is permanent but on some leaves the coloring is a contrast of dark and light greens and the brown may fade in drying towards olive. No. 7893, May 11th.

Thlaspi arvense Linn. Penny Cress. The lowermost or basal, oblanceolate, petioled leaves of this species are seldom seen on herbarium specimens as they are early deciduous and usually have fallen by the time the plant begins to bloom. Detroit, No. 2054, July 8th, 1908, and No. 7921, June 2nd, 1927; Yysilanti, No. 5450, May 30th, 1920; S. Rockwood, No. 5870, June 14th, 1921; Brighton, No. 7701, May 5th, 1926.

Sinapis arvensis Linn, f. *stricta* (Celak.) Thell. A form of the Charlock with the pods appressed to the rachis. Lake Linden, No. 8114, September 3rd, 1927.

Arabis lyrata Linn. Rock Cress. Typical specimens of this species have been collected on rocky shores and hills in Keweenaw County. It is distinguished from the variety by its more slender, tapering style or beak. No. 154, August 1st, 1884, and No. 154a, September 12th, 1887.

Arabis lyrata Linn, var. *intermedia* (DC.) O. A. F. This is distinguished from the species by its thick, cylindrical, non-tapering style, little if any narrower than the width of the pod; in the typical form of the species the stigma is much wider than the style and overhangs it but in this variety the style is as wide as the stigma. The old stems of the preceding year some of them with remnants of the fruits, are persistent into the flowering season, thus proving the plant to be a perennial in this region. Due West, No. 7909, June 1st. Previously collected at Rochester, No. 1533½, July 4th, 1896; near Washington, No. 4158, May 25th, 1916.

Arabis glabra (L.) Bernh. Tower Mustard. Tecumseh, No. 7978, June 21st. In more or less rocky situations throughout the state but nowhere frequent. Also at Detroit No. 1455, June 15th, 1894; Keweenaw County, No. 1455a, June 28th, 1895, Rochester, No. 3664, June 11th, 1914; Royal Oak, No. 4208, June 17th, 1916; Woodville, No. 5960, August 4th, 1921; Grand Ledge, No. 6570, June 10th, 1923; Parkedale, No. 6951, July 2nd, 1924; S. Rockwood, No. 4943, July 16th, 1918.

Arabis Canadensis Linn. Sickle Pod. In the same situations as *A. glabra* and equally infrequent. Tecumseh, No. 7975, June 21st, 1927. Also at Detroit, No. 1571, September 8th, 1897; Island Lake, No. 1571a, July 16th, 1905; Rochester, No. 3665, June 11th, 1914; Yysilanti, No. 5244½, June

15th, 1919; Franklin, No. 5520, June 24th, 1920; Hambrug, No. 6264, July 12th, 1922; Parkedale, No. 6950, July 2nd, 1924; Redford, No. 4750, October 14th, 1917.

Arabis laevigata (Muhl.) Poir., var. *heterophylla* O.A.F. Hillsides near Temperance, No. 7996, July 13th.

Geum vernum (Raf.) .T. & G. Spring Avens. Frequent in thin woods at Rockwood. No. 7940, June 8th.

Geum macrophyllum Willd. In thin woods at Eloise, No. 8022, July 27th.

Rubus neglectus Peck. Purple Raspberry. Robust specimens in a Tamarack swamp in mature fruit. Fruits large, red, and of excellent flavor. Stems four or five feet high, and curving over, and rooting at the tip. Washington, No. 8042, August 3. Nos. 5713 and 7836 referred here with much misgiving in the preceding number of this series, undoubtedly are *R. melanolasius* Focke.

Rubus Allegheniensis Porter. Blackberry. A plant of the uplands, open fields, and sunny places. Stems and glands *red;* inflorescence racemose; fruit dry, aromatic, narrowly oblong or cylindrical. Detroit, No. 1976, June 18th, 1906. Rochester, No. 1976a, June 8th, 1909. Eloise, No. 8031, July 27th. Wayne, No. 8035, July 27th.

Rubus Allegheniensis Porter, var. *nigrobaccus* (Bailey) N. Comb. (*R. nigrobaccus* Bailey). Stems purplish, glands *black;* fruit juicy, sweet, not at all aromatic, hemisphaerical to thimble-shaped. Usually in thin woods. A plant of shady places. The plant with sweet, juicy fruit and black glands certainly should be recognized as distinct from the one with aromatic fruit and red glands. Our commonest blackberry. Detroit, No. 1365, June 10th, 1893. Whitmore Lake, No. 7965, June 15th. Ypsilanti, No. 7985, June 29th. A variation of this with corymbiform inflorescence may be known as subvar. *sativus* (Bailey) N. Comb. (*R. villosus* var. *sativus* Bailey.) Fence rows and borders of small thickets. Royal Oak, No. 2127, August 24th, 1909. Ypsilanti, No. 7984, June 29th. Eloise, No. 8032, July 27th.

Rubus flavianus Blanchard. In thin woods at Palmer Park, Detroit, No. 2097, July 31st, 1909.

Rubus permixtus Blanchard. In similar situations as the preceding. Rochester, No. 2100, August 13th, 1909.

Rubus argutus Link. (*R. Andrewsianus* Blanchard). Dry, sandy grounds. Detroit, No. 2022, June 16th, 1907. Parkedale, Nos. 2867, July 14th, 1912 and 3427, June 8th, 1913.

Rubus frondosus Bigel. Rocky hillsides. Cliff Mine, 183a, June 20th, 1885; Whitmore Lake, No. 8019, July 20th.

Rubus pergratus Blanchard. Banks, etc. Alexis, Ohio, near the State boundary. No. 6497, May 30th, 1923.

Rubus Canadensis Linn. (*R. Millspaughii* Britt.) Smooth, not prickly; open, sunny fields among rocks. Cliff Mine, No. 183b, June 28th, 1895.

Rubus elegantulus Blanchard. Somewhat similar to the last, but slightly prickly. Cliff Mine, No. 184, August 22nd, 1884, and No. 3064, August 22nd, 1912.

Rubus Baileyanus Britt. Dewberry. Trailing. Leaves pubescent. Stony Creek, Oakland Co., No. 3439, June 8th, 1913; Algonac, No. 3693, June 21st, 1914, and 3800, July 28th, 1914; Belle Isle, No. 1292, August 6th, 1892; Keweenaw Co., No. 1292a, August, 1900.

Rubus flagellaris Willd. Leaves glabrous, or nearly so, inflorescence corymbose. Keweenaw Co., No. 183, August 22nd, 1884. Palmer Park, No. 183c, July 4th, 1896. Rochester, No. 2957, July 28th, 1912; No. 2974. August 4th, 1912; No. 3220, October 21st, 1912. Royal Oak, No. 5587a, August 12th, 1920. Algonac, No. 3692, June 21st, 1914; No. 3799, July 26th, 1914.

Rubus procumbens Muhl. (*R. subuniflorus* Rydb.) Flowers usually solitary. Royal Oak, No. 5587b, August 12th, 1920.

Rubus Enslenii Tratt. Growing on sand. Rochester, No. 1541, July 4th, 1896. Detroit, No. 1541a, May 26th, 1898. Rochester Nos. 2603, June 2dn, 1912 and 2871, July 4th, 1912. Stony Creek, Oakland Co., Nos. 3440 and 3447, June 8th, 1913. Woodbridge Park, No. 5804, May 30th, 1921.

Rubus nigricans Rydb. Low grounds. Keweenaw Co., No. 1734, August 15th, 1901. Palmer Park, No. 1734a, July 31st, 1909.

Rubus hispidus Linn. Swamp Dewberry. Detroit, No.

1387, July 3rd, 1893. Parkedale, No. 3055a, August 4th, 1912. Ferndale, No. 3182, August 14th, 1912. Algonac, Nos. 3691, June 21st, 1914 and 3798, July 26th, 1914. Dearborn, No. 4512c, July 8th, 1917.

Pyrus coronaria Linn. Crab Apple. This species has many varieties due to the variations in leaf cutting and pubescence. Sargent took as the type a form with unlobed, evenly serrate leaves. But Linn described his species with leaves "serrato-angulosis." We must therefore look for a variation with *lobed* ("angulosis") leaves when delimiting the type form. Such a form is found in variety *elongata* (Rehder) Bailey and this variety must be considered as the trinomial type of the species. Just as good reasons may be advanced for taking *P. glaucescens* for the typical form of the speices but less confusion may arise if the lobed form of the current understanding of *P. coronaria* be designated. The form adopted by Sargent as the type (*Malus coronaria* L. [*sic*] in Manual of the Trees of N. Amer. [1922] 382, fig. 339) may be known as *Pyrus coronaria* Linn, var. *fragrans* (Rheder) N. Comb. (*Malus fragrans* Rehder). The above variations with glabrous calyx tubes and green leaves I have not found in Michigan. All that I have observed have a tomentose calyx tube and mature leaves thick and glaucescent beneath. It has always been reported as *P. coronaria;* it may be more appropriately known as *Pyrus coronaria* Linn, var. *tomentella* N. Var. (*Malus glaucescens* Rehd.) The varital name refers to the tomentose condition of the calyx tube at flowering time. Eames, No. 8142, September 28th. Previously collected on Belle Isle, No. 1353, May 27th, 1893, and at Parkedale, No. 3347, May 11th, 1913.

Crataegus pruinosa (Wendl.) C. Koch. Along fence rows at Eames, No. 8141, September 28th. Farmington Junction, No. 8154, October 5th.

Crataegus alnorum Sarg. Small shrubs with well matured fruit. Ortonville, No. 8120, September 21st.

Cretaegus coccinea Linn. (*C. pedicellata* Sarg.) Some of the leaves are broad enough to be called transversely elliptical. Ypsilanti, No. 5454, May 30th, 1920.

Crataegus tomentosa Linn. Abundant in Southeastern

Michigan. Fruit globular, dull, becoming brighter red, 3 or 4 lines in diameter. Farmington Junction, No. 8155, October 5th. Previously collected on Belle Isle No. 1078a, May 27th, 1893; at Orion, No. 1078c, May 30th, 1895; Parkedale, No. 3550, October 5th, 1913; Northville, No. 6456, October 18th, 1922.

Crataegus tomentosa Linn, var. *structilis* (Ashe) N. Comb.. *C. structilis* Ashe. Fruit larger, more succulent, often somewhat flask-shaped, usually of a brighter red, less frequent. Farmington Junction, No. 8153, October 5th. Previously collected on Belle Isle, No. 1712, June 9th, 1901; and No. 1885, October 18th, 1904; at Parkedale, No. 3227, October 27th, 1912; and No. 4418, September 3rd, 1916.

Chamaecrista fasciculata (Mx.) Greene. Partridge Pea. A single low specimen of this species was gathered by Mr. Gladewitz on our excursion to Monroe, August 17th. It was just outside of the northern city limits of Monroe on the right-of-way of the electric interurban service. No other specimen was observed.

Trifolium pratense Linn. Red Clover. Naturalized from Europe. Probably also native. I can see no real reason for not considering this species native as well as *T. repens*. Differs from the next species in its solid stems and appressed pubescence below the flower-head. Pubescence in this species brownish, in the next white. Lake Linden, No. 8098, August 23rd, 1927. Calumet No. 8099, August 24th, 1927.

Trifolium Pensylvanicum Willd. (*Trifolium pratense* L., var. *sativum* Schreb.; *T. pratense* American authors at least in part not Linn.) Red Clover. Cultivated and naturalized everywhere. Keweenaw County, No. 109, June 26th, 1884; Ypsilanti, No. 109a, June 21st, 1892. Detroit, No. 109b, August 4th, 1892; Rochester No. 2667, June 11th, 1912; Parkedale, No. 2944½, July 28th, 1912. Forma *albiflora* N. F. Flowers white often turning pink as they age. Keweenaw County, No. 110, June 26th, 1884; Monroe, No. 5914b, July 6th, 1921; Metamora, No. 6647, July 18th, 1923; Washington, No. 8037, August 3rd; Newport, No. 8075, August 17th.

Amorpha fruticosa Linn. False Indigo. A lone shrub was discovered by Mr. Gladewitz. It is on the banks of the Huron

between Ann Arbor and Geddes. So far as we are aware, this is the first time this species has been found in and reported for Michigan. No. 7990, June 29th.

Amorpha canescens Ph. Leadplant. Detroit, No. 1544, July 23, 1896; Galesburg, No. 5557, July 20th, 1920.

Lathyrus sylvestris Linn, var. *Wagneri* A. Schwartz. This was cultivated many years ago as a forage plant but its use for this purpose was long since discontinued. It escaped to roadsides and now in one place forms a fairly thick hedge about 40 yards long by 10 feet wide. Also along fences. It is still spreading. Near Temperance, No. 7999, July 13th.

Linum sulcatum Ridd. Wild Flax. Grassy fields. A good sized stand of it. Ortonville, No. 8132, September 21st. Island Lake, No. 1802a, July 16th, 1905.

Linum medium (Planch.) Britt. First collected on Belle Isle, No. 1802, July 8th, 1903. Roadsides near Royal Oak where rather abundant. No. 5587, August 12th, 1920.

Linum Virginianum Linn. A good stand of this was found on a grassy bank near Wayne. No. 7842½, September 10th, 1924.

Oxalis stricta Linn. Yellow Sorrel. *O. cymosa* Small. This species is frequent throughout southeastern Michigan. The typical form has an essentially glabrous stem. Several variations were found at or near Stony Creek in Monroe County, August 17th, No. 8086. A variety has villous stems and may be known as *O. stricta* var. *villicaulis* (Wieg.) N. Comb. *O. Europocea* f. *villicaulis* Wieg. Rhodora (1925) XXVII 135. No. 8088. Also var. *rufa* (Small) Farw. with reddish purple foliage, No. 8087. And var. *Bushii* (Small) Farw. wilth the upper surface of the leaflets strigose. No. 8089.

Oxalis Dillenii Jacq. With the preceding. No. 8090.

Polygala polygama Walt. Bitter Milkwort. Rather scarce. Island Lake, No. 1929, July 16th, 1905. Algonac, No. 2824, July 7th, 1912; and No. 2824a, June 17th, 1925. There is a variation with stems widely spreading but not prostrate, bearing from the axils of many leaves reflexed branches with terminal racemes of cleistogamous flowers. These racemes point earthward but do not penetrate the ground. This may

be called variety *ramulosa* N. Var. In sandy soil at Algonac. No. 8068, August 10th.

Polygala sanguinea L. Purple Milkwort. Rather common but not abundant. This species has three color forms, purple, white and an intermediate form. Linn described the first as *P. sanguinea* and the last as P. viridescens which may be known as *P. sanguinea* f. *viridescens* (L.) N. Comb. I have collected the typical form (f. *typica*, N. F.) with purple flowers, at Ypsilanti, No. 1198, August 12th, 1891. Detroit, No. 1198a, July 18th, 1893. Algonac, No. 3785, July 26th, 1914. Anchorville, No. 6395, September 27th, 1922. Algonac, No. 8060, August 10th. Forma *viridescens* (Linn) O.A.F., has some of the flowers greenish white and others the same with an added purplish tinge. Detroit, No. 1641, June 30th, 1899; Algonac, No. 3784, July 26th, 1914, and No. 8070, August 10th. Forma *albescens*, N. F. Flowers white, the standard with a midrib green for .5 to .75 of its length. Algonac, No. 8066, August 10th. Previously at Detroit: No. 1482½, September 6th, 1894; No. 1622½, September 20th, 1898; No. 1641½, June 30th, 1899.

Euphorbia dentata Mx. Annual. Rather scarce in Michigan. Generally in rather poor soil. Newport, No. 8074, August 17th,.

Impatiens Balsamina Linn. Garden Balsam. Waste grounds at Farmington, No. 8161, October 5th.

Hypericum Ascyron Linn. Low grounds near Whitmore Lake. Scarce. No. 8010, July 20th. Ortonville, No. 8135, September 21st. Previously collected in Keweenaw Co., No. 718, August 20th, 1889, and at Birmingham, No. 718a, September 27th, 1898.

Lechea Leggettii Britt. & Holl. Low grounds at Monroe. No. 8096, August 17th.

Viola Missouriensis Greene. This species is quite common in moist thickets. Due West, No. 7916, June 21st. Also at Inkster, No. 7346½, May 20th, 1925; Eloise, No. 7353, May 20th, 1925; Algonac, No. 7427, June 17th, 1925.

Viola peramoena Greene. One of our most beautiful violets. Stems caespitose in large clumps. Near Washington, No. 7901, May 18th, 1927.

Viola vagula Greene. In this species, the presummer leaves are always strongly purple underneath. It usually grows in wet marshy grounds, but I have seen it growing on coal cinders. Near Oxford. Nos. 6887, 6888, and 6893, June 4th, 1924; Parkdale, No. 2550a, May 25th, 1913; Rochester, No. 6871a, May 14th, 1924.

Viola nephrophylla Greene. Near Erie, in low, moist grounds between the horns of a more or less crescent shaped ridge. No. 7857, May 5th. Also, Nos. 6878 and 6885, May 21st, 1924.

Viola nephrophylla Greene, f. *albinea* N. F. Flowers white except for purple veins on the spurred petal. Dr. Brainerd called this *V. papillionacea*, an *albino*, yet called No. 6878 *V. nephrophylla*. But there is absolutely no difference between the two except in the color of the petals; if one is *V. nephrophylla*, then the other is also. With the above, No. 7859, May 5th. Also, No. 6881, May 21st, 1924 and No. 5725, May 10th, 1921, from the same station, the latter number having been reported as *V. Missouriensis*.

Viola nephrophylloides N. Sp. Leaves ovate, cordate, mostly obtuse, crenate, deeply toothed near the base; intermediate in character between *V. fimbriatula* and *V. nephrophylla*, with both of which it is associated. Dr. Brainerd considered it to be a new hybrid (*V. fimbriatula X nephrophylla* Brainerd, in litt.) See illustrations. No. 7858, May 5th; also, No. 6877, May 21st, 1924.

VIOLA NEPHROPHYLLOIDES N. Sp.

VIOLA NEPHROPHYLLOIDES N. Sp.

Viola emarginata (Nutt) Le Conte. This species in its typical form with glabrous, deltoid leaves, apparently is not known from Michigan. Our plant is more or less pubescent and ciliate, but the late Dr. Greene said it was nevertheless this species. First collected at Detroit; No. 862a, May 1st, 1896; No. 1603, May 14th, 1898; No. 1772½, May 19th, 1902; No. 1603b, August 29th, 1920; No. 1603c, May 8th, 1921. Romulus, No. 6162, June 7th, 1922. Royal Oak, No. 4211a, July 13th, 1916, and No. 4211, June 18th, 1916. Algonac, No. 3643, May 24th, 1914; No. 3643a, August 10th.

Viola fimbriatula Sm. A low plant with the short petioled, pubescent, broadly ovate leaves in a rosette. The upper surface of the leaves are more or less shiny. Midsummer plants essentially the same, the petioles remaining much shorter (2-3 the length of the blade or less) than the ovate-lanceolate blades (which are 1.5 by 3.75 inches). Detroit, No. 862, May 1st, 1896; No. 1603a, May 6th, 1907. Algonac, No. 2584, May 27th, 1912; No.2584a, June 17th, 1925; No.3642, May 24, 1914. Eloise, No. 7362, May 20th, 1925; No. 7362a, June 10th, 1925; No. 7362b, May 11th, 1927; No. 7888, May 11th, 1927; No. 7888a, July 27th, 1927; Wayne, Nos. 7891 and 7896, May 11th, 1927; No. 7891a, July 27th, 1927. Another form has fewer leaves, not in a rosette, these narrowly ovate to oblong, and not shiny above; the summer leaves are ovate to oblong and obtuse to narrowly triangular and acute on very long petioles as long as, or longer than the blades. It is this form (No. 6880) that Dr. Brainerd considered to be one parent of a new hybrid of *V. nephrophylla*. The summer stage resembles very much that of *V. subsagittata*. Near Erie; No. 6880, May 21st, 1924; No. 6880a, July 30th, 1924; No. 6884, May 21st, 1924; No. 7856, May 5th, 1927; No. 7992, July 13th, 1927. Temperance, No. 7855, May 5th, 1927; Monroe, No. 7307, April 29th, 1925, and No. 7307a, August 17th.

Viola fimbriatula Sm., f. *albescens* N. F. Like the narrow leaved form above, but the flowers are white except for the spur tip and the purple veins of the lower petals. Erie, No. 7860, May 5th.

Viola blanda Willd. White Violet. A conspicuous plant in the midsummer woods at Washington. No. 8043, August 3rd.

This is the summer stage of No. 6485, May 23rd, 1923.

Viola pubescens Ait., f. *eriocarpon* (Nutt.) O. A. F. Pittsfield, No. 6211, June 28th, 1922.

Viola pubescens Ait., var. *scabriuscula* (Schw.) T. & G. Near Farmington, No. 6151, May 23rd, 1922. Forma *leiocarpa* (Fern. & Wieg.) O. A. F. In rich woods near Farmington. No. 7877, May 8th, 1927 (flowers bright yellow), and No. 7879 (flowers pale yellow or cream color). Near Farmington, No. 6150, May 23rd, 1922. No. 7879 is the pale flowered segregate named by Dr. Greene, *V. achlydophylla.*

Viola striata Ait. Low grounds in sparse woods. Eloise No. 7883, May 11th.

Viola striata Ait., f. *albiflora* N. F. Flowers white, without purple veins. Perhaps the *Viola albiflora* Link, Enum. (1821) I, 241. Eloise, No. 7884, May 11th.

Viola tricolor Linn. Pansy. Along the shores of Torch Lake at Lake Linden. Scarce. No. 8105, August 28th, 1927.

Ludwigia alternifolia Linn. Seedbox. Low grounds at Monroe. No. 8097, August 17th.

Angelica atropurpurea Linn. Angelica. Low, moist grounds at Geddes. No. 7989, June 29th. Collected previously at Dundee, No. 5291, July 15th, 1919; Monroe, No. 5809, June 2nd, 1921.

Pyrola Asarifolia Mx. Wintergreen. Near Whitmore Lake, No. 7960, June 15th.

Pyrola Asarifolia Mx., var. *ovata Farwell.* Near Whitmore Lake, No. 7961, June 15th.

Nummularia hybrida (Mx.) N. Comb. *Lysimachia hybrida* Mx. Fl. Bor. Am. (1803) I, 126. Loosestrife. Eloise, No. 8024, July 27th. Previously collected at Detroit, No. 1511, June 30th, 1896.

Nummularia lanceolata (Walt.) O. K. Differs from the above in its much smaller and shorter leaves and in its longer pedicels which in this species are longer than the bracts and in the nearly entire corolla lobes. Detroit, No. 1843, August 13th, 1904.

Asclepias purpurascens Poir. Rare. Roadsides near Temperance, No. 7997, July 13th.

Asclepias verticillata Linn. No. 6648 reported on p. 275,

Vol. 8 of this journal had the stems tufted, bearing filiform-linear leaves about two inches long by .5 of a line wide; these were very numerous, erect, forming a dense mass of foliage. Stems 2—2.5 feet in height. This probably is the typical form of the species. Another form has single stems bearing few, spreading, longer and broader leaves, about 2.75 inches by 1.5 lines. This probably is var. *linearis* (Scheele) Pollard. Ortonville, No. 8133, September 21st.

Ascerates Floridana (Lam.) Hitchc. Near Temperance, rare. No. 8001, July 13th.

Volvulus sepium (L.) Junger. Hedge Bindweed. Flowers pure white. Fields at Superior, No. 7988, June 29th; near Whitmore Lake, No. 8012, July 20th.

Phlox divaricata Linn. f. *albiflora* O. A. F. Associated with the specific type (bluish or lilac) and the forma *purpurea*. Although the flowers are pure white when fresh, yet in drying they become more or less bluish. Rockwood, No. 7924, June 8th.

Mentha piperita, Linn. Peppermint. Largely cultivated in southern Michigan for the production of oil. It is found as a naturalized plant throughout Michigan. The typical form of the species is glabrous, and is the form described by Sole in 1798 as var. *officinalis*. It is in use by those who prefer a trinomial name for the specific type. Detroit, No. 1806, July 18th, 1903; Keweenaw Co , No. 284½, July 26th, 1885.

Mentha piperita Linn, var. *sylvestris* Sole. This is a variation that is more or less pubescent on the leaf petioles, etc., and is the variety *subhirsuta* Bentham. The older name of Sole should supercede the later one of Bentham. It is far less frequent than the typical form of the species. Keweenaw Co., No. 347, Sept. 4th, 1885; Birmingham, No. 347a, Sept. 27th, 1898.

Pentstemon hirsutus (L.) Willd., f. *albiflorus* O. A. F. This white flowered form of the species is quite plentiful at Flat Rock. No. 7943, June 8th.

Pedicularis Canadensis Linn, Mant. (1767) I, 86. Linn based his species upon plants collected in North America by Kalm and described it with white flowers (*Corallae albae*). Thus the typical form (forma *typica*, N. F.) is white flower-

ed. In Rhodora (1814) XVI, 128, Mr. A. H. Moore described the red flowered form as forma *preclara*. There are two other color forms: one with the upper lip and dorsal parts yellow, and the lower lip and ventral parts paler or cream color (f. *flava*, N. F.) ; and one with the upper lip and dorsal parts red and the lower lip and ventral parts yellow (f. *bicolor*, N. F.)

Pedicularis Canadensis L., f. *typica*. Not seen as yet in Michigan. Forma *praeclara*, A. H. More. The lower lip is red but very much paler than the upper. Near Farmington Junction, No. 7875, May 8th, 1927; Wayne, No. 7898, May 11th. Forma *flava*. Near Farmington Junction, No. 7876, May 18th, 1927; Wayne, No. 7897, May 11th. Forma *bicolor*. Near Farmington Junction, No. 7878, May 8th, 1927; Wayne, No. 7899, May 11th.

Plantago Rugellii Dec. Our common native Plantain with glabrous foliage and purple petiole bases. Wayne, No. 8034, July 27th. Abundant throughout the State. Previously collected on Belle Isle, No. 1331, September 7th, 1892. Detroit, No. 2519, September 14th, 1911. Parkedale, No. 2990, August 4th, 1912.

Plantago Rugellii var. *asperula* Farwell. Has more or less roughish pubescent foliage and scapes. Wayne, No. 8033, July 27th.

Galium Labradoricum Wieg. This was growing in profusion near Whitmore Lake. No. 7952, June 15th.

Viburnum Acerifolium Linn, var. *ovata* Rehder. Arrowwood. Nearly all the leaves are entine, but two or three are typically lobed as in the specific type. Tecumseh, No. 7971, June 21st.

Viburnum affine Bush. This has been reported heretofore as *V. dentatum*, which species in so far as my knowledge goes is not found in Michigan. Parkedale, No. 3406, May 25th, 1913; and No. 4187a, June 11th, 1916; Rochester, No. 3920, October 25th, 1914, and No. 4417a, September 3rd, 1916; Pittsfield, No. 5740, May 15th, 1921.

Viburnum affine Bush, var. *hypomalacum* Blake. This has been reported heretofore as *V. pubescens*, which name is now transferred to another species than the one for which it has stood for a century or more. Whitmore Lake, No. 7967, June

15th. Previously collected in Keweenaw Co., No. 394, June 30th, 1886; Orion, No. 394a, August 29th, 1895; Birmingham, No. 394b, September 9th, 1897; Parkedale, No. 2620, June 2nd, 1912, No. 2639, June 9th, 1912, and No. 3419, June 8th, 1913; Detroit, No. 3416½, May 31st, 1913; Pittsfield, No. 5743, May 15th, 1921, and No. 6212a, June 28th, 1922.

Callistemma hortense Cass. China Aster. Waste grounds at Farmington Junction. Scattered over considerable territory. No. 8151, October 5th.

Erigeron Philadelphicum Linn. In fields and open woods. Rockwood, No. 7927, June 8th. Previously in Keweenaw Co., No. 477a, July 28th, 1887; Ypsilanti, No. 477b, June 21st, 1892; Detroit, No. 477c, June 8th, 1893; Parkedale, No. 2772, June 30th, 1912.

Erigeron Philadelphicum Linn, f. *purpurum* (Ait.) N. Comb. (*E. purpureum* Ait.) The ligulate flowers are a deep rose purple. In the typical species they are pale pink or whitish. If color forms are worth naming, this one certainly deserves recognition. The earlier botanists even went so far as to consider it a distinct species. Rockwood, No. 7928, June 8th. Also, previously in Keweenaw Co., No. 477, September 10th, 1886; Bois Blanc, Ontario, Canada, No. 477d, June 13th, 1905; Rochester, No. 2710, June 11th, 1912.

Gnaphalium purpureum Linn. Purple Cudweed. Michigan is north of the range given in our manuals, but it has been found in Macomb, St. Clair, Wayne, and Monroe counties. In fields near Temperance, No. 7995, July 13th. Previously at Detroit, No. 1609, July 12th, 1898.

Helianthus scaberrimus Ell., var. *subrhomboideus* (Rydb.) Farwell. One of our rare sunflowers. Newport, No. 8076, August 17th.

Helianthus giganteus Linn, var. *altissimus* (Linn) O.A.F. Wild Sunflower. This variety is readily differentiated in the field by its prominently glauceous stems, generally glabrous below the branches and by the colorless tips of the chaff. Washington, No. 8039, August 3rd.

Helianthus Maximiliani Schrad., var. *Dalyi* (Britt.) O.A.F. Along the Ann Arbor Railroad near Ann Arbor, No. 8020, July 20th.

Coreopsis tinctoria Nutt. Tickseed. Common in cultivation, Escaped into vacant lots, etc. Detroit, No. 8052, August 10th.

Anthemis arvensis Linn. Corn Chamomile. Similar to the Mayweed or Dog Fennel, but without its offensive odor. The typical form has the chaff exceeding the disk flowers. Keweenaw Co., No. 693, September 10th, 1888; Detroit, No. 693a, July 15th, 1902; Parkedale, No. 4014, August 26th 1915. A variation with the chaff shorter than the disk flowers is the var. *agrestis* (Wallr.) DC. It flowers about a month earlier than the species. Roadside ditches near Due West, No. 7920, June 1st; Whitmore Lake, No. 7948, June 15th. Also at Rochester, No. 2083, June 16th, 1909.

Cirsium altissium (Linn) Spr. Thistle. In rich woods at Eames. Scarce. No. 8144, September 28th.

Cichorium Intybus Linn, f. *alba* Farwell. In fields near Eloise, No. 8023, July 27th.

Tragopogon major Jacq. Banks along the Ann Arbor road near Whitmore Lake. This is the 2nd known station for this species in North America, both being in Michigan, about 100 miles apart. No. 8013, July 20th.

Hieracium scabrum Mx. Hawkweed. A fine, large specimen of the typical form of this species was found on the barren hills back of Lake Linden. This is the first time I have observed it on the Keweenaw Peninsula. No. 8102, August 25th, 1927. Near by were a number of plants of the common form of this region, the var. *tonsum* Fernald. No. 8103.

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CONTRIBUTIONS TO THE BOTANY OF MICHIGAN, NO. 15

Miscellaneous Notes.

OLIVER ATKINS FARWELL

SCIRPUS

Scirpus atrovirens Muhl. Bulrush. In swampy places. Usually plentiful. Keweenaw Co., No. 549, August 22, 1887. On Belle Isle, No. 549a, July 21, 1893, and No. 965a, July 17, 1895. Rochester No. 3701, June 28, 1914. Junior, No. 5069; and Harris, No. 5079, July 13, 1918. River Rouge, No. 4343a, July 21, 1916. Detroit, No. 1640½, June 30, 1899; No. 1652b, August 12, 1899; 1657b, September 15, 1899. A variation with narrower, more sharply acute and paler scales is var. *pallidus* Britton. Detroit No. 1640, June 30, 1899. Keweenaw Co., No. 1640a, August 22, 1887. Another variation with non-nodulose leaves and spikes usually without bristles is var. *Georgianus* (Harper) n. comb. (*S. Georgianus* Harper). Michigan is included in its range, but I have not found it except in its *proliferous* stage which may be known as sub-var. *viviparus* n. subvar. Detroit, No. 5622, August 29, 1920. Another variation has the peduncles and pedicels shortened so that the inflorescence is reduced to a close, irregular head. This is var. *pycnocephalus* Fernald. Parkedale, No. 3021, August 4, 1912. Detroit, No. 1652a, August 12, 1899. [In the Herb. of P. D. & Co. is a sheet of the var. *Georgianus* from East Greenwich, N. Y., where collected by Dr. Asa Fitch in 1867. Also, a sheet of subvar. *viviparus* from Little Falls, N. J., where collected by Dr. H. H. Rusby in 1879.]

UNISEMA

In checking over the herbarium of Parke, Davis & Co., I find that the following new combinations under *Unisema* are necessary in order that the plants may be put away under their proper names.

Unisema lancifolia (Muhl.) n. comb. (*Pontederia lancifolia* Muhl. Cat. [1813] 34; Ell. Sk. [1817] I. 382. *P. lanceolata* Nutt Gen. [1818] I. 216.) Fernald says it is impossible to determine whether Muehlenberg and Elliott had the plant known as *Pontederia angustifolia* Ph. or the *P. lanceolata* Nutt. The probabilities are that Muehlenberg's species is the same as Nuttall's and in the absence of type material I designate the southern plant having opaque leaves with a short, free portion of petiole as the species intended by Muehlenberg. As Muehlenberg's name has priority, it should be retained.

Unisema lancifolia (Muhl.), f. *trullifolia* (Fernald) n. comb. (*P. lanceolata* f. *trullifolia* Fernald).

JUNCUS

Juncus acuminatus Mx. Rush. A species of Rush that is well distributed but never very frequent in any one place in so far as my observations go. Zoo Park near Royal Oak, No. 4319, July 13, 1916. Shelbyville, No. 6577, June 21, 1923. Erie, No. 6991, July 30, 1924. Algonac, No. 7275, October 15, 1924, Dearborn, No. 4516d, July 8, 1917, and No. 4532c, July 14, 1917. A variation with the flowers replaced in whole or in part by viviparous buds producing leaves while still attached to the plant has been named *J. paradoxus*. It may be known as *J. acuminatus* Mx., var. *paradoxus* (E. Mey.) n. comb. It is rarely seen in this section. Keweenaw Co., No. 511a, June 6, 1888. Detroit, No. 1390, July 3, 1893. [In the herbarium of Parke, Davis & Co. is a specimen from Franklin, N. J., where collected by Dr. H. H. Rusby in June, 1878].

Juncus alpinus Vill. Fernald in Rhodora vol. 10 p. 49 and Robinson and Fernald in Gray's New Manual pp. 270 and 277, describe the typical variety of this species as with castaneous flowers, the glomerules with one or more flowers elevated on pedicels above the others. But the typical variety as illustrated in Reichenbach's Icones Fl. Germ. et. Helv. vol. 9, plate 403, figs. 897 to 900, is a plant with all flowers in the glomerules sessile and the heads appearing almost black. This is the low alpine plant to which the name was originally

applied. I have found it at Copper Harbor. Very scarce. No. 1614c, August 23, 1898. A somewhat similar but larger plant with greenish or straw-colored flowers is the variety *fuscescens* Fernald. This has been collected at Parkedale, No. 3850, August 9, 1914. Belle Isle, No. 1609a, July 12, 1898, and No. 1391, June 13, 1895. A somewhat similar variety but with one or more flowers of each glomerule, pedicelled and raised above the others, is var. *insignis* Fries. It is well represented in Reichb., l. c., fig 896. I have collected this on Belle Isle, No. 1391, July 10, 1893. C. F. Wheeler collected it at Mackinac City August 12, 1890, and at Charlevoix, September 7, 1892. Another variety similar to the last but with castaneous flowers and capsules may be known as var. *Americana* n. var. (*J. alpinus* Amer. authors, at least in part). Frequently plants will be found in which all the glomerules are regularly formed. Much larger (12-18 inches high) than the typical variety (about 10 inches high) and the heads appear a glossy brown rather than black. Clifton, No. 837a, August 23-30, 1894. [The var. *insignis* was collected on Walpole Isl., Ont., Canada, No. 7093c, Sept. 3, 1924].

Juncus nodosus Linn. Now known to range nearly all over the North American continent. [Schaffner's No. 217, 1879, from San Luis Potosi, Mexico (Herb. P. D. &Co.) belongs here]. I have collected it at Clifton No. 512, August 1, 1887. On Belle Isle, No. 512a, July 16, 1892. Shores of Cass Lake, No. 7224, October 1, 1924. Parkedale, No. 3018, August 4, 1912.

POLYGONATUM

Since my paper on the Michigan species of this genus was published (Bulletin of the Torrey Botanical Club, Vol. 42), R. R. Gates and B. F. Bush have each presented a revision of the genus as found in America, the former in the Bulletin of the Torrey Botanical Club (Vol. 44) and the latter in the American Midland Naturalist (Vol. 10). Gates differs from me in his selection of a type for *Convallaria biflora* Walt., but can give no real, scientific reason for changing it. As a matter of fact, he does not do so, since he is mistaken as to the identity of Rusby's New Jersey specimens taken by me to be the same thing that Walter had. Gates never saw these

specimens, so when he writes that they are not nerved and so cannot be the same as Walter's, which are nerved, I am at a loss to find the basis of such a statement, unless it was the result of some sort of a dream. He selects the narrowest and rarest leaf form of the species, a form that Walter probably never saw. The commonest forms are the ones the ancient botanists dealt with, not the rarest; therefore, the probabilities are that Walter had a plant more similar to the ones of Rusby than to those of Chapman selected by Gates as typical of *P. biflorum*. Though I have not seen the Chapman specimens, I think that they cannot differ materially from the Rusby collection; they are narrower, but that is about all. They belong to the same category. *P. biflorum* is characterized by its narrow, elliptical-lanceolate leaves, cuneate or tapering at base. Rusby's specimens belong here; the longest leaf is 4.5 inches in length, and the broadest leaf is 11 lines wide at its widest part. It has prominent lateral veins. Gates' variety, *hebetifolium*, is based on plants with broader, shorter, more obtuse leaves without prominent lateral veins. The characters are good except the one last named, which is not constant. At least, all specimens that I have seen of the variety will show leaves with more or less prominent lateral veins in at least the lower or basal parts of the leaves.

Bush has referred a number of Deam's Indiana plants to this variety. I have seen some of Deam's numbers and some of them are mixed, containing specimens of both the type and the variety. He also referred Deam's No. 27603 to *P. Virginicum* Greene, with which it has no relation whatever. Deam's No. 27603 merely duplicates his Nos. 27234 and 27585, both of which Bush correctly referred to *P. bifolium* var. *hebetifolium* Gates, which he raised to specific rank. All three numbers belong here, with the exception of a part of No. 27585, which is good *P. biflorum*. *P. biflorum* var. *Virginicum* is based upon a plant in the U. S. Nat. Herb., sheet No. 36169. It has eliptical leaves 2 to 4½ inches long by .75 to 1.75 inches wide, narrowed or acutish at base. Like var. *ovatum*, it approaches *P. canaliculatum* as to size of plant only. It probably is restricted to Virginia; certainly it is not found in Indiana. I am indebted to Mrs. Chase for tracings of

P. Virginicum Greene, for which I tender my sincere thanks. Bush ignores *P. canaliculatum* Pursh. It is an older name than *P. commutatum*, and probably applies to some variation of it. Gates puts it in the uncertain and little known list on account of its *pubescent margins* (*tantum tenuissime pubescentibus*). I take it that such a described pubescence would require the use of a lens to observe it, and just such a pubescence (a very minute ciliolation) may be thus found on the margins of the leaves of what I have designated as *P. canaliculatum* and its varieties.

I agree with Gates that *P. boreale* is not specifically distinct from *P. pubescens*, but I would maintain it as a good variety rather than reduce it to the status of a pure synonym. The only difference is in the shape of the leaves and, as might be expected, they intergrade and pass one into the other. *P. hirtum* (Bosc.) Pursh is an older name than *P. pubescens*, but it applies to a species not now known. If found, it probably will prove to be quite distinct from *P. pubescens*. It was described as with pubescent stems and peduncles. I imagine that *P. parviflorum* (Poir.) Dietr. is a synonym of *P. canaliculatum* var. *Americanum*, perhaps a dwarfed or starved form collected while the plant was still in bud only.

My present understanding of the Michigan species is as follows.

P. pubescens (Willd.) Ph. Leaves suborbicular to broadly elliptic. Walled Lake, No. 4487, June 5, 1917; Detroit (Mill Road), No. 5448, May 23, 1920; shores of Marl lake, No. 5697, September 18, 1920. The following were originally referred here, but the specimens are not now available for re-examination: they may in part be *P. boreale*. Keweenaw Co., No. 380, June 20, 1886. Parkdale, No. 2983, August 4, 1912; No. 3472, June 15, 1913; No. 3969, June 13, 1915. Rochester, No. 3624, May 17, 1914.

P. pubescens (Willd.) Ph., var. *boreale* (Greene) n. comb. (*P. boreale* Greene). Leaves oval to elliptical-lanceolate. Walled Lake, No. 4489, June 5, 1917. Detroit (Mill Road), No. 5447, May 23, 1920. Probably belonging here are the following. Keweenaw Co., No. 380a, June 20, 1886. Ypsilanti, No. 380b, May 21, 1891. Detroit (Palmer Park) No. 3952,

May 31, 1915. These numbers are not available for re-examination. [As pointed out by Bush, Rusby's specimens from Mass. and N. J. belong here].

P. pubescens (Willd.) Ph., var. *boreale* (Greene) Farw., subvar. *australe* (Farw.) n. comb. (*P. boreale* var. *australe* Farwell). Rochester, No. 4819, May 15, 1918. Detroit (Mill Road), No. 5449, May 23, 1920, and No. 380d, May 9, 1895. The above have leaves rounded at the base. The following have the leaves more or less cuneate.

P. pubescens (Willd.) Ph., var. *cuneatum* (Greene) Farw. Detroit, No. 380c, May 9, 1895. Keweenaw Co., No. 3909, Sept. 27, 1914. Detroit (Palmer Park), No. 3951, May 31, 1915. Walled Lake, No. 4490, June 5, 1917. It has been observed in various other places.

P. pubescens (Willd.) Ph., var. *multiflorum* (Farw.) n. comb. (*P. boreale* var. *multiflorum* Farw.) I can see no good reason for elevating this to specific rank, as has been done by Bush. Walled Lake, No. 4488, June 5, 1917. I have not observed it elsewhere.

[*P. bifolium* (Walt.) Ell. Not observed in Michigan. As pointed out above, Rusby's N. J. collection belongs here and not with the variety *hebetifolium* to which it was referred by Gates. Also, undoubtedly all the collections cited by Gates. Likewise Deam's No. 27887, and that part of No. 27585 which shows narrowed or cuneate leaf bases. W. C. Johnson, Grane Creek, Miss., April 3, 1918.

P. bifolium (Walt.) Ell., var. *hebetifolium* Gates. The leaves in this variety are shorter, broader, and have rounded bases. Belonging here are Deam's No. 27603 (erroneously referred by Bush to *P. Virginicum* Greene, which does not occur in Indiana), No. 27234, and that part of No. 27585 which shows leaves with rounded bases. Also collections cited by Gates, except Rusby's N. J. collection, which is typical of the species].

P. biflorum (Walt.) Ell., var. *ovatum* Farwell. Leaves ovate to ovate-lanceolate (up to 5 inches by 2 inches) with rounded bases. The variation of the species with the largest leaves. Belle Isle, No. 1150a, June 8, 1893. Near Rochester, No. 3674, and at Parkedale, No. 3678 and No. 3679, June 11,

1914. A variation of this with ancipital stems (elliptical in cross-section) may be known as subvar. *ellipsoidale* n. subvar. Rochester, No. 4508½, June 28, 1917.

Polygonatum canaliculatum (Muhl.) Pursh. (*P. canaliculatum* var. *oblongifolium* Farw.) Leaves oblong or rarely elliptical-lanceolate, minutely ciliolate (*margine tantum tenuissime pubescentibus*). The variatal name may be construed as the trinomial type of the species. Belle Isle, Nos. 1150½, July 23, 1892 and 1150b, June 8, 1893. Parkedale, Nos. 3676 and 3677, June 11 and Nos. 3682 and 3683, June 19, 1914. Rochester, Nos. 4236a and 4237a, June 25, 1916. Rockwood, No. 4234, June 24, 1916. [Deam's No. 27801 from Indiana belongs here].

P. canaliculatum (Muhl.) Pursh., var. *Americanum* (Hook.) Farw. Leaves ovate-lanceolate or somewhat broader. Our commonest Solomon's Seal and by most confused with the following variety. As a varietal name *Americanum* antedates *commutatum* by 35 years. To be sure, it was all embracing but it is quite appropriate to reserve it for the most prominent part of the aggregation. Ypsilanti, No. 1150, June 13, 1891. Rochester, No. 3675, June 11, 1914. Rockwood, No. 4235, June 24, 1916. A variation with ancipital stems may be known as subvar. *ellipticum* (Farwell) n. comb. (*P. ellipticum* Farw.) Rochester, No. 3673, June 11, 1914.

P. canaliculatum (Muhl.) Ph., var. *giganteum* (Dietr.) Farw. By far the largest of our Solomon Seals often reaching a height of 7 feet or more. Lower leaves round ovate or suborbicular, upper broadly oval, up to 7 inches in length or more. Parkedale, No. 3473, June 15, 1913.

P. melleum Farw. Flowers honey yellow. Algonac, No. 3974, June 16, 1915.

QUERCUS—THE OAKS

Of the oaks accredited to Michigan by Dr. Beal in his Michigan Flora I have found all but two (*J. Leana* and *Q. Schneckii*) and one (*Q. stellata*) that Dr. Beal does not mention. The only oak collected on the Keweenaw Peninsula by me is the Scrub Oak (*Quercus borealis* Mx. f.) I can see no good reason to support the shifting of *Q. rubra* from the

Northern Red Oak to the Southern Red Oak. Plukenet's t. 54, fig. 4, Sargent concedes may be *Q. rubra* as currently understood; also the acorn on Catesby's plate 23. Likewise, Linn's variety B. *Q. rubra* Linn, should therefore stand for the Northern Red Oak with Plukenet's t. 54, figures 4 and 5 as the foundation, excluding the reference to Gronovius.

Quercus alba Linn. The White Oak. Said to occur in the Upper Peninsula, but I have not detected it there; but a lone oak tree in a cleared 20-acre field near Calumet, Mich., is said to be the White Oak. I was never near enough to determine its identity. Well distributed over the Lower Peninsula. Usually in rather dry upland woods. Belle Isle, No. 881, Sept. 18, 1895. Parkedale, No. 3255 and No. 3271, October 27, 1912. Bloomfield, No. 5100, Sept. 8, 1918. Slocum's Island, No. 5981a, August 31, 1921. Monroe, No. 6716, August 22, 1923.

Quercus stellata Wang. Post Oak. Only one tree has been found. Probably at some time in the distant past it was more numerous. On the banks of Paint Creek near Rochester, No. 4583, Sept. 13, 1917, and No. 5192, Oct. 6, 1918.

Quercus macrocarpa Mx. Bur Oak. Said to occur in the Upper Peninsula, but I have not detected it there nor heard of it. Well distributed over the Lower Peninsula. In upland woods or in richer soil. Often called Cork Oak because of the often corky ridged branches. Belle Isle, No. 1488, Oct. 19, 1894. Parkedale. No. 3225 and No. 3246, Oct 27, 1912. Franklin, No. 5160, Sept. 23, 1918. Rochester, No. 5182 and No. 5191, Oct 6, 1918. Monroe, No. 6715, Aug. 22, 1923.

Quercus bicolor, Willd. Swamp White Oak. In low, wet grounds. Frequent. Ypsilanti, No. 1091, May 30, 1891. Belle Isle, No. 1091a, May 9, 1895. Monroe, No. 6714, Aug. 22, 1923.

Quercus Muehlenbergii Engelm. Chestnut Oak. Rich, wet woods. Scarce now, but was said to have been abundant in the early history of Michigan. Leaves narrowly oblong to lanceolate. Birmingham, No. 1583, Sept. 9, 1897.

Quercus Muehlenbergii Engelm., var. *Alexandri* (Farwell) Farwell. (*Quercus Alexanderi* Britt.) Leaves obovate and the bark more ridged and flaky. In moist, rich woods or even on

dry upland soil. Birmingham, No. 1687, Oct. 2, 1900. Detroit, No. 3517, Oct. 4, 1913. French Landing, No. 6174, June 7, 1922. Newport, No. 6225, July 5, 1922. Parkedale, No. 6952, July 2, 1924.

Quercus Prinoides Willd. Similar to the preceding but usually a low shrub. Upland copses. Birmingham, No. 1584, September 9, 1897. Ypsilanti, No. 4835, May 19, 1918. Near Marl lake, No. 5714, September 18, 1920. Orion, No. 6837, September 26, 1923.

Quercus rubra Linn., p. p. and var *B*. Sp. Pl. (1753) 996 and of DuRoi, Harbk. Baumz. (1772) ii, pl. 5. (*Quercus maxima* [Marsh.] Ashe, Proc. Soc. Amer. Forest. [1916] XI. 90, *Q. borealis* Mx. f., var. *maxima* [Marsh.] C. S. Sarg., Rhodora [1916] XVIII 48. Red Oak. Widely distributed in southern Michigan. The type form of the Northern Red Oak. Belle Isle, No. 946, August 21, 1895. Monroe, No. 6711, August 22, 1923. Hamburg, No. 6771, September 5, 1923. Rochester, No. 6853, October 3, 1923.

Quercus rubra Linn, var. *ambigua* (Mx. f.) Fernald. (*Q. ambigua* Mx. f., Hist. Arb. Amer. [1812] II. 120, pl. 24; *Q. coccinea* Linn, var. *ambigua* A. Gr. Manual, [1867] 454; *Q. rubra* Linn, var. *borealis* [Mx. f.] Farwell, Ann. Rpt. Mich. Acad. Sci. [1904] VI. 206) A scraggy shrub or small tree on rocky bluffs where it is rather plentiful and in places forming almost impenetrable thickets. Called Scrub Oak. Never heard it called Gray Oak, as given in Manuals, etc. In the rich valleys of the Keweenaw Peninsula there is a large tree (100 feet more or less in height and about 3 feet in diameter) called Red Oak, but as I have never collected either fruit or leaves, I cannot say if it belongs here or to the typical variety. Keweenaw Co., No. 71, August 31, 1883.

Quercus palustris Muench. Pin Oak. In low, moist grounds. Well scattered over the southern part of the state. Belle Isle, No. 1337, September 16, 1892. Monroe, No. 6712, August 22, 1923.

Quercus ellipsoidalis E. J. Hill. (*Q. coccinea x palustris* Hill.) Yellow Oak. Generally to be found on clay, sandy or gravelly grounds. Parkedale, No. 3274, October 27, 1912. De-

troit, No. 1572, September 8, 1897. Eames, No. 8138, September 28, 1927.

Quercus coccinea Muench. Scarlet Oak. Well distributed over the Peninsula. Usually in dry, upland soil. Birmingham, No. 1582, September 9, 1897. Rochester, No. 4414½, September 3, 1916. Parkedale, No. 4417b, September 3, 1916. Monroe, No. 6713, August 22, 1923. Hamburg, No. 6271b, July 12, 1922, and No. 6770, September 5, 1923. Orion, Nos. 6836 and 6839, September 26, 1923. Rochester, No. 6852, October 3, 1923. Ortonville, No. 8118, September 21, 1927.

Quercus velutina Lam. Black Oak. Scarce. Usually in dry, sandy upland soil. Birmingham, No. 1581, September 9, 1897. Parkedale, No. 3267, October 27, 1912. Rochester, No. 6868, October 17, 1923.

Quercus imbricaria Mx. Shingle Oak. Alluvial grounds. Only a single tree was found. Geddes, No. 2122, August 21, 1909.

ACALYPHA

Acalypha Virginica L. Mercury. A common enough plant everywhere. Not particular as to habitat as it is found in more or less open woods or in fields and pastures or on alluvial lowlands; on dry more or less sterile grounds or in wet, rich, or mucky lands. Variable as to habit; simple or copiously branched, from an inch or two to one or two feet. Dr. George Suttie collected this at Detroit in August in 1888 and in 1892. I collected it at Washington, No. 6001, September 14, 1921. On Belle Isle No. 1207a, August 4, 1892. Detroit, No. 1403c, July 25, 1893. Parkedale, No. 2842, July 14, 1912. Ypsilanti, No. 1207, September 2, 1891.

Acalyphs gracilens A. Gr. Said to have been collected at Detroit by Dr. D. Clark. Have looked for it continually, but have not found it at Detroit. When I did find it, seemingly, I was unable to recognize it. Found it on sterile hill-tops near Washington, one of Dr. Clark's old stamping grounds, and published it as *A. Virginica* Linn, f. *purpurea* n. f. Washington, No. 6002, September 14, 1921.

PRUNELLA

Prunella vulgaris Linn. Selfheal. Heal All. Borders of woods, copses, fields, etc. Leaves rounded at base or the radical subcordate. In Keweenaw Co., No. 769½, July 25, 1895. In the variety *Pennsylvanica* (Willd.) Nutt. the leaves are larger, narrower, and tapering at the base. On Belle Isle, No. 317b, July 25, 1893.

STACHYS

Stachys palustris Linn. Hedge Nettle. Leaves short and broad, ovate-oblong, subordate, 2 or 3 inches by .5 to 1. Wet grounds near Clifton, No. 280, July 26, 1885. In the type form, the sides of the stems are appressed pubescent. In the variety *homotricha* Fernald, the sides of the stem are hirsute. On the Mendota location in Keweenaw Co., No. 1826a, August 4-11, 1904. In the variety *arenicola* (Britt) n. comb. (*S. arenicola* Britt.) the leaves are linear (4 to 6 inches long by .25 to .5) and are more densely pubescent. The stems are hispid on the sides. When I first collected this, I sent a specimen to the Gray Herbarium, if my memory serves me rightly, suggesting that it was not to be found in the Manual and that it probably was an unnamed variety of *S. palustris*. The response was to the effect that it was only *S. palustris*. Many times I have been on the verge of publishing it, but have delayed until now. In sandy locations at Clifton, No. 281, July 26, 1885.

SOLIDAGO

Solidago. Goldenrod. Away back in 1893 or 1894 when studying our Shore Goldenrod, collected on rocky shores at Copper Harbor, Keweenaw Co., Mich., I discovered that the name under which it was passing (*S. humilis* Ph.) was untenable because of an earlier *S. humilis* Miller. Being uncertain of the synonymy appertaining to our Shore Goldenrod, I sent specimens to Dr. T. C. Porter, requesting him to rename our Shore Goldenrod, suggesting the name *S. Solandri* if there were no published name applicable. Dr. Porter agreed to investigate and did so, but discarded my suggested name for one of his own selection. I asked why the change? I got no

explanation but an offer of a supplementary publication explaining and changing the name to the one suggested by me. I declined on the grounds that Porter's name already published could not be set aside. The name, *Solidago Purshii*, Porter, was not intended to replace *Solidago humilis* Pursh of the Fl. Am. Sept. based upon a plant in the Banksian herbarium as it is now understood; but to give a name to the Shore Goldenrod of the Lake Superior District which was passing as *S. humilis!!!* To be sure, at that time, both were thought to be identical, but that will not invalidate the application as intended, since actual specimens from the Lake Superior district were sent with the request, as mentioned above, and the new name was intended to apply to them as the type rather than as a literary exchange for the name of the *Fl. Am. Sept.*, hence Porter's refusal to quote that publication. In Rhodora Vol. 10, 88-91, Fernald adopts *S. racemosa* Greene and gives his reasons therefore. But Greene's name is three years later and does not apply to the common variation of the species. Fernald says: "Porter rejected the name *S. humilis* Pursh and *assigned to the plant which has been passing as Pursh's S. humilis the name S. Purshii* [italics mine] defining his species merely by the citation of the synonym *S. humilis* Pursh. The name *S. Purshii* Porter is therefore strictly synonymous with *S. humilis* Pursh; and the names *S. humilis* and *S. Purshii* are equally untenable for the plant of our northeastern riverbanks and cliffs." Fernald seems to contradict himself. If *S. Purshii* was applied to the plant passing as *S. humilis* Pursh, which it certainly was, it is just as certain that it can not be "strictly synonymous with *S. humilis Pursh*," and cannot be "untenable." For my part, whenever occasion occurs I shall use the name *S. Purshii* Porter for our Shore Goldenrod as it was the original intention of myself and Dr. Porter that such should be the case. All plants from the Keweenaw peninsula which I have observed have glutinous involucres and stems and leaves more or less so. Copper Harbor, No. 501, July 28, 1887; No. 501a, August 20, 1898; 501b, August 16, 1921; Eagle Harbor No. 6601, June 29, 1923. [Plants from the Potomac region, not at all glutinous were named by Dr. Greene *S. racemosa*. This non-glutinous variation may be

known as *Solidago Purshii* Porter, var. *racemosa* (Greene) n. comb.]

Solidago humilis Miller (*S. nemoralis* Ait.) Dwarf, Field or Grey, Goldenrod. The *Index Kewenis* refers this name to *S. Canadensis* Linn., which is characterized by three nerved leaves. Miller fails to give any information about a three-nerved leaf, which he would have done if his species were some variation of *S. Canadensis*. It is pretty certain, therefore, that the leaves are not three-nerved and that the species is not *S. Canadensis* Linn. It should be looked for amongst those species the leaves of which are not prominently three-nerved. The low stature and the leaves would at once suggest *S. nemoralis* Ait. But the inflorescence of this species as usually found in Michigan in no wise fits the description of Miller. Ever since I took the steps that resulted in the banishment of *S. humilis* Pursh, I have been trying to find a way of satisfactorily placing *S. humilis* Miller, but without avail. In 1927, however, I found a field with luxuriant *S. nemoralis* with a paniculately corymbiform inflorescence such as is described by Miller, and I have no doubt but that is just what Miller had. I note that Mackenzie has come to pretty much the same conclusion, independently. The plants range up to 42 inches in height and are copiously branched from the axils of the leaves on the upper third of the stem. The branches range up to 10 inches in length and are clothed with small foliaceous bracts; they are erect and all together form a more or less trumpet-shaped, erect inflorescence. Only the uppermost quarter section of the branch bears flowers, and these are aggregated into a compact, ovoid, one sided, recurved, and flattened thyrse up to 2½ inches long and about 1 inch wide at the lower end. Ortonville, Nos. 8121 and 8126, Sept. 21, 1927. The ordinary form of this species as found in Michigan has a simple stem, and is much lower in stature, about 30 inches. Thyrse terminal, more or less elongated and cylindrical, or branched and ovate, up to 9 or 10 inches long by 1 to 5 inches wide. It may be known as var. *reducta* n. var. Detroit, No. 933a, Sept. 27, 1895; No. 1621a Sept. 20, 1898; No. 1869, Sept. 9, 1904; No. 1947a, August 30, 1905. Parkedale, No. 3125, Sept. 2, 1912. Goodison, No. 5381, Sept.

4, 1919. Algonac, No. 7271, Oct. 15, 1924. Ortonville, No. 8122, Sept. 21, 1927. Monroe, No. 8095, August 17, 1927 (immature). Washington, No. 8038, August 3, 1927 (immature). In the above the basal and radical leaves are oblanceolate and acute. In the following the radical leaves are spatulate and rounded to spatulate-oblanceolate and acute. This may be known as subvar. *spatulata* n. subvar. Orion, No. 933, August 29, 1895. Pittsfield, No. 7828, Sept. 29, 1926. Birmingham, No. 933b, Sept. 27, 1898.

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THE STRATIGRAPHY AND LARGER FOSSILS OF THE PLATTIN FORMATION IN STE. GENEVIEVE COUNTY, MISSOURI.*

I. INTRODUCTION

The principal Plattin exposures whose rocks and fossils are here discussed lie some seven miles south of the town of Ste. Genevieve, Missouri, and near the village of Ozora. On the Weingarten topographic sheet of the United States Geological Survey the region in which the exposures lie is shown by a large hill lying south of the Beckett Hills, and to the right of the River Aux Vases. It extends some distance west of the hill, and in a southeasterly direction to the Little Saline Creek. For convenience in reference the name South Beckett Hill is here used for the unnamed hill of the map, while the general area is referred to as the Little Saline region, from the name of the creek flowing through it.

Most of the fossils were collected on South Beckett Hill, though a few represent exposures south and west of it. Collections were made by Dr. Stuart Weller from exposures along Gabouri Creek, some two and one-half miles west of Ste. Genevieve, and these have been included among the material examined.

II. ACKNOWLEDGMENTS

The field work in preparation for this paper was carried on under the direction of the late Dr. Stuart Weller, and a considerable part of the paleontologic study was done at the Walker Museum of the University of Chicago, thereby receiving the benefit of Dr. Weller's criticism. Although the figured types remain in the Chicago collections, a series

* Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 3.

of paratypes and plesiotypes, and a number of casts have been deposited in the University of Cincinnati Museum, along with metatypes of some Plattin and Decorah species previously described.

The data for Section III, F, dealing with the relationships of the Plattin strata of Ste. Genevieve County to those of other districts in Missouri, have been contributed *in toto* by Dr. Josiah Bridge, of the Missouri School of Mines and Metallurgy. Dr. Bridge also has examined and commented on the generalized section of the Ste. Genevieve County Plattin.

III. STRATIGRAPHY

A. JOACHIM FORMATION

The geologic column of the eastern half of Ste. Genevieve County begins with the Potosi formation, of Ozarkian age. In the region of South Beckett Hill, however, the oldest formation exposed is the Joachim, belonging to the Big Buffalo series of Ulrich. It consists of 120 to 150 feet of limestone, yellowish to buff, and generally dolomitized. Except for small specimens of *Leperditia,* fossils are few and poor.

B. PLATTIN FORMATION

Upon the Joachim, and separated from it by an erosional unconformity, lie the 200 or more feet of limestone comprising the Plattin Formation in its Ste. Genevieve County phase. This, the southern equivalent of the Platteville of the upper Mississippi valley, was the particular object of field study. More than three weeks were spent on the exposures along South Beckett Hill alone. Several detailed sections were made, and though these show surprising variations, they possess key strata which make correlation easy. By means of them the following generalized section of the Plattin of South Beckett Hill has been prepared. Although no careful field work has been done in other localities, casual examination, and the collections made by Dr. Weller in the vicinity of Ste. Genevieve, indicate that this section will apply with fair

accuracy to the Plattin of Ste. Genevieve County. Its relation to the formation as a whole is discussed in Section IV.

GENERALIZED SECTION

	Feet	Inches
43.—Limestone in medium to heavy beds, with much chert. Pelecypods of the genera *Cyrtodonta* and *Vanuxemia* abundant; *Endodesma* sp. rare	8	
42.—Limestone, medium-bedded, largely replaced by brown chert. *Streptelasma corniculum medium, Strophomena plattinensis, Cyrtodonta* spp., *Vanuxemia* spp. the chief fossils	2	4
41.—Limestone, thin-bedded, with fossils in irregular lenses. *Strophomena plattinensis* and bryozoans common	6	
40.—Limestone, thin-bedded. *Strophomena plattinensis, Dinorthis deflecta gibbosa, Pianodema perveta, Orthis tricenaria* the only fossils identified	8	
39.—Limestone, thin-bedded, gray. *Streptelasma* and bryozoans common; *Isotelus maximus?* and *Bumastus* sp. not rare	8	
38.—Limestone, buff, dolomitic, cherty, weathering to small fragments. No fossils noted	9	6
37.—Limestone, buff to gray-buff, soft, crystalline. Algal (?) masses common	8	
36.—Limestone, buff to buff-gray, with numerous fucoidal cavities. Major beds 12 to 18 inches thick; minor ones 1 to 5 inches	5	
35.—Limestone, white, crystalline, algal, with large stromatoporoids and small masses of *Columnaria halli*		8
34.—Limestone, buff to gray-buff, medium bedded, with abundant fucoidal cavities	7	6
33.—Limestone, buff to grayish, heavily bedded, with fucoidal cavities	6	
32.—Limestone, buff to gray, thinly and unevenly bedded, cherty. Lower portions contain *Streptelasma corniculum medium, Monotrypa magna,* and *Dystactospongia minor* in abundance	8	6
31.—Limestone, fine-grained. Contains some algae (?), abundant specimens of *Strophomena plattinensis, Liospira, Trochonema, Clathrospira, Helicotoma tennesseensis* and *Leperditia fabulites*		4

	Feet	Inches
30.—Limestone, buff to gray, thinly bedded, with small fucoidal casts and cavities	3	4
29.—Limestone, gray, fine-grained; algae (?) common		4
28.—Limestone, buff to gray, fucoidal	2	4
27.—Limestone, buff to gray, fine-grained, with abundant fossils. *Columnaria halli* appears in small masses,, *Pianodema subaequata, P. perveta, Dinorthis deflecta gibbosa* are common; *Helicotoma tennesseensis* is rare. The diagnostic feature is the abundance of opercula belonging to *Maclurites bigsbyi dixonensis*. Shells are less common, and rarely can be extracted		2–4
26.—Limestone, gray, in beds 4 to 8 inches thick. Lower feet form the chief horizon of *Actinoceras gravicentrum. Eurystomites robertsoni* is rare. Casts of *Maclurites bigsbyi dixonensis* are common in the upper 10 inches; opercula are rare. *M. bigsbyi* small, rare	5	
25.—Limestone, gray, fuicoidal, with heavier bedding than No. 26. *Actinoceras gravicentrum* common	2	10
24.—Limestone, gray, thinly and irregularly bedded, weathering to heavy ledges. At the top a very large specimen of *Columnaria halli* was secured	5	6
23.—Limestone, gray, thinly bedded, fucoidal, capped by 1 to 2 inches of blue shale	2	6
22.—Limestone, buff to gray, fucoidal. At the top is a 6 inch layer crowded with *Zygospira variabilis*, scattered specimens of which are found throughout the member.	5	
21.—Limestone, buff to gray, regularly but thinly bedded, with chert lenses. Fucoidal molds large, suggesting *Buthotrephis brachiatus*	4	
20.—Limestone, buff, crystalline, medium-bedded, highly fossiliferous, but with the specimens mere fragments of bryozoans, brachiopods, gastropods and echinoderms	4	
19.—Limestone, thinly and irregularly bedded; fossils rare	14	6
18.—Limestone, buffish to gray, with heavier and less regular bedding than No. 19. Fossils rare and poor	7	
17.—Limestone, gray, heavily bedded, fucoidal	1	
16.—Limestone, white, thinly or medium-bedded, fractured. Contains tubes like those of No. 15	3	
15.—Limestone, white, fine-grained, hard, in beds 4 to 8 inches thick. Pierced by abundant vertical tubes or borings, whose fillings are yellow and dolomitic; these borings unite, two or three together, upward, so that they open		

	Feet	Inches
upon the superior bedding plane as a single tube. Horizon of *Paleophycus tubularis*, as identified in this paper	2	6
14.—Limestone, buff to gray-buff, in beds 2 to 6 inches thick. *Buthotrephis regularis* and *B.* sp. diagnostic; other fossils rare and poor.	19	
13.—Limestone, gray, algal; *Strophomena plattinensis* common, but poorly preserved. *Leperdita* common		7
12.—Limestone, buff to gray, thinly to medium in bedding, honeycombed by small fucoidal molds. In blocks on a talus slope were found one small mass of *Columaria halli*, a few specimens of *Streptelasma corniculum medium*, *Strophomena plattinensis*, *Pianodema subaequata* and *Leperditia fabulites*. Heavy talus prevents determination of horizons within the member	21	
11.—Limestone, gray, medium-bedded, fucoidal, weathering to ledges 12 inches or more in thickness. Poorly preserved gastropods and orthoceratoids uncommon	5	6
10.—Limestone, fucoidal, thinly and irregularly bedded	6	
9.—Limestone, buff to gray, thinly bedded, fractured, fucoidal	2	
8.—Limestone, gray, algal		6
7.—Limestone, grayish, thinly bedded, fractured; contains fucoidal casts 1 to 2.5 inches in diameter	3	
6.—Limestone, buff to gray, fucoidal, heavily bedded	2	
5.—Limestone, grayish, thinly bedded, fucoidal, fractured; weathers to small chips	3	
4.—Limestone, gray-buff, thinly bedded, fucoidal; weathers to layers 8 to 12 inches in thickness	4	
3.—Limestone, yellowish to greenish-gray, soft and shaly. *Protorhyncha* (?) *plattinensis* abundant, crowding the member wherever it is exposed. Like the *Zygospira variabilis* member, a persistent and readily identifiable horizon		6–8
2.—Limestone, buff, shaly, grading into buff shale. At one locality a few specimens of *Protorhyncha ? plattinensis* were found. No other fossils noted	5	
1.—Limestone, buff, fine-grained, dolomitic, weathering to polygonal blocks. Orthoceratoids the only fossils noted		6

Maximum Thickness, 207 Feet.

Examination of the individual sections from which the generalized one has been compiled shows that the numerous members may be grouped into six main divisions, each

of which is reasonably distinct in both lithology and fauna. Unfortunately, most of the Plattin fossils which have been described and identified range nearly throughout the formation in its Ste. Genevieve phase. Therefore, it has seemed advisable to designate but one of these six major units a zone, and to apply to others the noncommittal term of "beds."

SUMMARY SECTION

	Feet	Inches
6.—Brachiopod-Pelecypod Beds. Members 39-43. Limestones, thinly bedded, cherty, highly fossiliferous. Brachiopods and pelecypods abundant	32	
5.—Upper Columnaria Beds. Members 28-38. Limestones, medium or thinly bedded. *Columnaria halli, Monotrypa magna, Streptelasma corniculum medium* abundant in several layers. The first attains only a moderate size	44	2
4.—Lower Columnaria Beds. Members 22-27. Limestones, more heavily bedded than those of Number 5. Large heads of *Columnaria halli* throughout; *Maclurites* and *Actinoceras* in upper two-thirds	21	4
3.—Fucoidal Beds. Members 4-21. Limestones pitted by innumerable fucoidal molds; casts less common. Where present they often are soft, yellowish, dolomitic and porous. *Columnaria* rare; *Monotrypa* apparently lacking. Fossils relatively uncommon in the lower half	103	
2.—*Protorhyncha ? plattinensis* Zone Members 2-3. Limestone, shaly, with *Protorhyncha? plattinensis* abundant in the upper portion	5	8
1.—Basal Limestone Beds. Member 1. Limestone, fine-grained, which lies upon the eroded beds of the Joachim formation		6

C. DECORAH FORMATION

Upon the Plattin, and in some places apparently continuous with it, lie four to six feet of shale and shaly limestone, the Ste. Genevieve facies of the Decorah of Iowa and Minnesota. The characteristic fossils are *Strophomena dig-*

nata, S. delicatula, Pianodema perveta, and unidentified branching bryozoans. Of these species, the second and third are characteristic of the true Decorah.

The principal collections from this formation were secured by Dr. Weller, at exposures about two and a half miles west of Ste. Genevieve.

D. OTHER FORMATIONS

The remaining rocks of South Beckett Hill include the Kimmswick limestones, equivalent to the Galena of more northern regions, and bearing the typical Galena fossil, *Receptaculites oweni* Hall; the Fernvale, Thebes and Orchard Creek formations, of Richmondian age; and the Kinderhook, Keokuck and Burlington members of the Mississippian. The latter reach their full thickness for the region some distance east of South Beckett Hill.

Unfortunately, the shales of the Orchard Creek formation appear to be unfossiliferous, thus preventing any attempt to compare the fauna of that member with that of the Plattin and Decorah.

E. SILICIFICATION, CHERT

In numbers 22 to 43 of the general section of the Plattin formation silicified fossils are common, and many of those in lower members are similarly preserved. In some, such as the Streptelasma bed (number 32), fossils are silicified throughout. In others, notably the operculum bed (number 27), the silicification is largely superficial, so that shells preserved in silica near and above the surfaces of slabs are calcified at depths of from two to five millimeters.

Another indication of the superficiality of the silicification is found in the fact that in loose slabs the process is more nearly complete than in pieces of rock secured *in situ*. Such a specimen is shown in Fig. 10 of Plate IV, in which the outer part is siliceous, and the core a crystalline limestone. A specimen of *Streptelasma corniculum medium* in this slab consists, near the surface, of siliceous material, and toward its base, of calcite.

The beds and lenses of chert, moreover, are thin, small,

and superficial. The thickest of them occur in the upper members of the Plattin on South Beckett Hill, at points where the surface slopes gradually and residual soil, while thin, holds enough vegetation to prevent rapid run-off. Even in these lenses, however, silicification is commonly incomplete, and masses of crystalline limestone may be found almost surrounded by silica.

So far as the Plattin is concerned, therefore, the cherts of South Beckett Hill are of very recent origin, and the process by which they were made is now in progress. Whether or not this generalization can be extended to the Mississippian cherts of the same region I do not know.

F. RELATIONSHIPS OF THE STE. GENEVIEVE PHASE OF THE PLATTIN

The Plattin rocks of Ste. Genevieve County, with a maximum thickness of about 207 feet are considerably thicker than those of St. Louis County, some sixty miles to the northward. Dr. Bridge's most complete section for the latter region, taken at Nimm's Siding, one mile east of Glencoe, Missouri (Sec. 17, T. 44 N., R. 4 E.) shows part of the Joachim, 122 feet of Plattin, 16 feet of Decorah, and the two lowest members of the Kimmswick. In detail it is:

KIMMSWICK FORMATION

	Feet	Inches
15.—Limestone, massive, white to grayish, whose weathered surfaces show a coarse "worm-eaten" texture		13
14.—Limestone, coarse, white, containing *Endoriceras proteiforme* and *Receptaculites oweni*—the latter typical of the basal Kimmswick on South Beckett Hill		4

DECORAH FORMATION

	Feet	Inches
13.—Limestone, thin-bedded, arenaceous and argillaceous, with thin beds of greenish shale and some beds of pure limestone 1 to 6 inches thick. One bed in particular, some 6 feet from the top, contains *Pianodema subaequata* and *Stictoporella angularis*		16

(Numbers 13 to 15 outcrop in an almost vertical cliff Below them the beds are much covered by talus, and the section is transferred to the western edge of the hill, about one hundred yards distant.)

PLATTIN FORMATION

	Feet	Inches
12.—Covered interval of	15	
One or two thin beds of coarsely crystalline gray limestone contain *Streptelasma* and *Orthis tricenaria* in silicified specimens.		
11.—Limestone, gray, crystalline, containing many gastropods	1	
10.—Limestone, pale gray to pinkish, with fucoidal cavities	6	
9.—Limestone, crystalline, grayish, weathering to thin plates and grading into the overlying bed. Fossils uncommon	10	
8.—Limestone, thin-bedded, pinkish gray, weathering to white, with abundant fucoidal cavities. Throughout it are scattered thin fossiliferous layers, the richest ones being at the base and 25 inches below the top	42	
7.—Limestone, pinkish gray with fucoidal cavities; fossils Mostly covered by talus	27	
(Top of abandoned quarry)		
6.—Limestone, thin-bedded, pinkish to dove-colored, sub-lithographic in texture, without fucoidal cavities. Several thin fossil beds in the upper part	8	
5.—Limestone, massive, bluish to pinkish blue, weathering to yellow. Fresh rock breaks with conchoidal fracture; fucoidal cavities abundant. Lower 2 feet crowded with bryozoans	12	
4.—Shale, olive-green, laminated	1	6

JOACHIM FORMATION

	Feet	Inches
3.—Dolomite, thickly and evenly bedded (6 to 18 inches), pinkish to bluish gray in color, with conchoidal or semi-conchoidal fracture. Bedding somewhat irregular; no fossils seen	13	6
2.—Limestone, blue to gray, in beds 6 to 8 inches thick, interbedded with thin layers of green shale. Weathers to gray or buff; carries small knots of clear calcite	8	8
1.—Dolomite, gray, coarse, with very irregular bedding. Contains masses of clear calcite 12 inches or more in diameter	3	
(Floor of quarry. Rock similar to Number 1 is exposed in the floor, its upper surface being undulating and suggesting giant ripples.)		

Summary of Section:

Kimmswick Formation, lower beds	17 feet
Decorah Formation, approximately	16 feet
Plattin Formation	122 feet
Joachim Formation, upper beds	25+ feet

In this section the limestone which forms the base of the Plattin in the Little Saline region is lacking. Hand specimens from Number 4 contain numerous examples of *Protorhyncha plattinensis*, which indicate that horizon to be equivalent to Number 3 of the Ste. Genevieve County section. The fossiliferous beds of Number 12 probably correspond to Numbers 39 or 40 of the latter, and indicate that the difference in thickness between the two sections probably is caused by thinning rather than by omission of any major members in the St. Louis County section.

Near House Springs, in the De Soto quadrangle, Dr. Bridge found a large *Columnaria* about sixty feet below the Plattin-Kimmswick contact, at an exposure in which the thickness of the Decorah is fifteen or twenty feet. In the underlying fifteen feet he secured stromatoporoids, *Monotrypa magna* Ulrich and casts of *Maclurites*. *Actinoceras gravicentrum* appeared in the upper seventy feet of the formation, thus ranging higher than it appears in Ste. Genevieve County. Near Pacific, Missouri, the same species occurs about seventy feet above the base of the Plattin.

North of the Missouri River Dr. Bridge has found that the Plattin rarely exceeds fifty feet in thickness. Southward, on the other hand, it thickens markedly, and near Cape Girardeau exposures and drill holes indicate thicknesses of six hundred or more feet. In the upper hundred feet Dr. Bridge has collected specimens of *Tetradium cellulosum*, a species which occurs also at House Springs, although its horizon there has not been determined. *Orthis tricenaria* appears near the top of the formation, where it is abundant.

From these observations it appears that the Plattin of the Little Saline region, though some eighty-five feet thicker than that of St. Louis County, is essentially equivalent with it. The upper beds of the formation, as well as the Decorah, are found north of the Missouri River, but whether or not representatives of the entire Ste. Genevieve section are present Dr. Bridge has been unable to determine. In Cape Girardeau County the Plattin reaches its greatest known thickness. Only the equivalents of the upper part of the South Beckett Hill section have been determined, however, so it is uncertain whether the great thickness represents added beds in the lower part of the formation or merely a general thickening.

SOME NOTES ON DIBOTHRIOCEPHALUS PERFOLIATUS.

FRANCIS WENNINGER.

The specimens described in the following paragraphs were collected from material secured by the German South Pole Expedition of 1901-1903. They were sent to Professor Pintner, head of the department of invertebrate zoology in the University of Vienna, who placed the material at my disposition for determination and description.

The specimens, though now over a quarter of a century old, are in a remarkable state of preservation. Aside from a slight bleaching and some brittleness due to the action of the preservative fluid, the specimens are quite suitable for investigation.

Mention must be made here of the procedure followed in staining sections. The ordinary paraffin method was used, and the sections cut to a thickness of ten micra. Borax carmine as a staining agent proved unsatisfactory. The best results were obtained by using Ehrlich's hematoxylin preceded by iron alum. The sections were taken through the alcohol series and then treated with distilled water. They were then immersed in a bath of iron alum for about twenty minutes, washed in distilled water and stained for about five minutes with Ehrlich's hematoxylin. The stain is washed off under running tap water. Distilled water does not give results. Sections prepared in this way show every detail of structure, especially the nucleus.

Up to the present, about fourteen species of Bothriocephalidae have been described. But this number must be reduced to eleven because three specific names are evidently synonyms.

The species under consideration is *Dibothriocephalus perfoliatus*, (*Diphyllobothrium clavatum*, Railliet.) It was found in sevent specimens of a species of seal,—*Leptony-*

chotes Weddelii, where it inhabited the small intestine, accompanied, in several cases at least, by hundreds of specimens of small Bothriocephalids,—*D. mobilis* and *D. Wilsonii*.

D. perfoliatus attains a length of 25 centimeters. The proglotids reach a maximum width of 7 mm. The smallest specimen in the material in my possession has a length of only 6 mm. while the largest measures about 80 mm. It is worthy of note that none of the individuals has reached sexual maturity. This precluded all possibility of ascertaining the number or location of the uterine apertures. A rather thorough examination of all the material in my possession seems to warrant the conclusion that the worm reaches maturity only at a considerable distance from the strobila. An outstanding characteristic of the species is the shortness of the individual segments and their overlapping, not only on the succeeding segment but, in many cases, on the two following segments. In mature segments measuring .45 mm the overlapping portion will measure .7-.8 mm. In regard to the number of segments, the following observations will be of interest. A specimen that measured 120 mm had 450 segments. In the first 5 mm of the strobila, the segments measured .03 mm in length; from 5 to 15 mm, the segments measured 1 mm; from 15 to 30 mm, .28; from 30 to 60 mm, .37 and from 60 to 120, .45 mm in length. There is a gradual increase in the breadth of the segments, the maximum being reached at about 2 centimeters from the end of the strobila, where it measures 6 mm. The cuticle is quite thick,—.016 mm. Underneath the cuticle there is a strongly developed subcuticular muscle sheath. The muscles of the parenchyme are powerfully developed and consist mainly of muscle bundles that measure up to 1 mm. Transverse muscle fibers are present in large numbers though they seem to be underdeveloped. The dorso-ventral bands of muscle are again well developed. Scattered in through the entire parenchyme there are numerous calcium bodies. These measure .12 mm.

The excretory system shows considerable branching. It appears to consist peripherally of 16 tubes of which 8 are

dorsal and 8 ventral. The branching is carried even into the overlappings of the proglottids. The anastomosis of the excretory system is especially remarkable in the region of the scolex. Some at least of the excretory tubes are surrounded by two sheaths of muscle, one longitudinal and the other a sphincter muscle. The reproductive organs develop quite slowly. Mature ova were not found in any of the shorter specimens, and even in fully developed worms, these occur only 6 or 7 centimeters after the scolex. The male reproductive organs are those commonly found in all Cestoda. The testes are nearly round and have a diameter of .06 to .08 cm. A cross section shows about 14, while a sagittal sections shows from 3 to 6. The total number in one individual is certainly in the neighborhood of 120. The cirrus sac is pyriform and about .24 mm long with a diameter of .12 mm. The cirrus is thick. The seminal vesicle is .14 mm long and .1 mm in diameter. The muscular development here is especially remarkable whereas it seems to be lacking in the cirrus itself.

The female reproductive organs are the type usually found in all Cestoda. One interesting departure from type must be noted. The uterus shows very little branching. Usually only one loop on either side is filled with mature ova. The loops are uniformly about .9 mm in diameter. Railliet has called attention to the fact that the uterus does not open behind the cirrus and vagina but irregularly to the right or to the left and never near the cirrus. The reason for this might be found in a foreshortening of the proglottis. The ova measure .06 to .064 mm in length and .045 to .048 mm in breadth.

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NOTES ON TREES AND SHRUBS OF MISSOURI

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Review of Swallow's Trees and Shrubs of Missouri.

I have just received a book entitled "Geological Report of the Country along the line of the South-western branch of the Pacific Railroad, State of Missouri," prepared by G. C. Swallow, State Geologist of Missouri, assisted by B. F. Shumard and G. C. Broadhead.

This report apparently was prepared during 1857 and 1858 and was finished on June 2, 1858, and deals primarily with geological matters, building stone, lime, soils, water, clays, minerals and other products that were of more commercial importance to the railroad about to be constructed; and secondly, with a dissertation on the native species of *Vitis;* a notice of the timber, trees, shrubs and vines that occur in the region contributory to the line of the railroad, by G. C. Swallow, B. F. Shumard and G. C. Broadhead; and a catalogue of trees and shrubs found in the Counties in the territory included in the plan of the survey, by G. C. Swallow, State Geologist.

This survey began in Saint Louis county, and passed through Washington, Jefferson, Franklin, Maries, Moniteau, Taney, Vernon, Camden, Gasconade, Laclede, Phelps, Pulaski, Dallas, Polk, Saint Charles, Ste. Genevieve, Cape Girardeau, Dent, Dade, Barton, Crawford, Wright, Stone, Webster, Pemiscot, Greene, Barry, Lawrence, Jasper and Newton Counties and ended in McDonald County, 32 counties in all.

Title on the cover reads "South West Branch," but the title

on the frontispiece reads "South-western Branch," and I have accepted this last.

The portion dealing more or less with trees and shrubs is divided into three parts, the first, by G. C. Swallow, beginning on page 11, and ending on page 23, is a dissertation on the native species of *Vitis* of Missouri, the cultivation thereof, and the making of wine; the second part, beginning on page 74 and ending on page 76, is a short notice of the principal trees, shrubs and vines observed during the course of the survey by G. C. Swallow, B. F. Shumard and G. C. Broadhead, in several Counties in Missouri; and the third part is a catalogue of the trees and shrubs found in the Counties which were included in the survey, by G. C. Swallow.

Beginning with the first part, I note that Swallow lists seven species of *Vitis* for the region included in the survey, as follows: *Vitis Labrusca*, Fox Grape, *V. aestivalis*, Summer Grape, *V. cordifolia*, Winter Grape, *V. riparia*, River Grape, *V. vulpina*, Muscadine, *V. bipinnata* and *V. indivisa*.

Of *V. Labrusca*, Swallow says it is common in all parts of the State, but this species does not occur in Missouri, and I am compelled to believe that Swallow must have mistaken some form of *V. aestivalis* for this species, or possibly the form that I now take to be *V. Linsecomii glauca*, which is common in Carter, Reynolds, Shannon, Texas, Wright, Webster, Greene, McDonald and Newton Counties.

Swallow included *V. bipinnata* and *V. indivisa* in his report on the native species of *Vitis*, but these are not grapes at all, and he should have included *Vitis quinquefolia* along with them, as this species is as much a grape as they, and he does list it in the catalogue on page 83. On page 16 Swallow says "from this list it will be seen that Missouri possesses all the native grapes of our country save one, the *Vitis Caribaea* D. C., of California."

This statement is certainly remarkable, inasmuch as Swallow does not list *Vitis rubra* Michx., and *V. rupestris* Scheele, known Missouri species, and *V. Caribaea* D. C. is a Gulf Coast species, and not found in California, as so stated by him.

On pages 74 and 75 under the head of timber, Swallow gives a list of some 42 species of trees, shrubs and vines, for the most part correctly identified, as follows: *Acer saccharinum, A. barbatum glaucum, Aesculus* sp., *Asimina triloba, Betula nigra, Carya alba, C. ovata, C. laciniosa, C. amara, Cercis canadensis, Corylus americana, Celtis* sp., *Fraxinus americana, F. quadrangulata, F. sambucifolia, Gleditschia triacanthos, Juglans nigra, J. cinerea, Morus rubra, Negundo aceroides, Prunus americana, Maclura pomiferum, Prunus serotina, Platanus occidentalis, Quercus alba, Q. marilandica, Q. stellata, Q. macrocarpa, Q. rubra, Q. bicolor, Q. velutina, Q. palustris, Q. imbricaria, Q. falcata, Q. Muhlenbergii, Rhus* sp., *Ulmus americana, U. fulva, U. alata, Vitis rotundifolia, V. aestivalis,* and *V. Labrusca.*

As I have stated above, this list of names is mostly correctly given, the only ones I object to are *Prunus americana, Fraxinus sambucifolia* and *Vitis Labrusca,* the last of these I have alluded to under *Vitis* in the first part of this report we are dealing with.

At this place it may be observed that it is rather remarkable that during all the years that Swallow and Broadhead were studying the geology and palaeontology of Missouri, and observing and making notes on trees and shrubs and plants of the State, that they never found a new species, or had a species named for either one or the other.

On page 75 under the head of timber are some abstracts from B. F. Shumard's County reports, of Crawford, Phelps, Pulaski and LaClede Counties, which enumerate some of the principal trees and shrubs observed, some 21 species in all, nearly all of them correctly named as follows: *Acer barbatum glaucum, A. saccharinum, Celtis* sp., *Carya alba, C. ovata, C. amara, Cornus* sp., *Asimina triloba, Gleditschia triacanthos, Juglans nigra, J. cinerea, Quercus alba, Q. coccinea, Q. macrocarpa, Q. stellata, Q. velutina, Q. marilandica, Sambucus canadensis, Tilia* sp., *Ulmus americana* and *U. fulva.*

The only doubtful name in this short list of species is that of the Scarlet Oak, which I can scarcely believe was known

to Shumard at that time, as it was some sixty years later that this species was definitely shown to occur in the State, after years of search, and an intensive study of *Quercus* species.

It is interesting to note here that some two years later, Prof. Buckley dedicated *Quercus Shumardii* to Mr. Shumard, a conspicuous oak of the swamps and lowlands of the southeastern part of Missouri to Louisiana and Texas.

It is very evident that Shumard did not attempt to give anything but a general view of the woody species of these Counties, as the presence of such conspicuous trees and shrubs as *Quercus rubra, Q. bicolor, Q. Muhlenbergii, Q. imbricaria, Cercis canadensis, Gymnocladus dioica, Ostrya virginiana, Carpinus caroliniana, Juniperis virginiana, Diospyros virginiana, Platanus occidentalis, Amelanchier canadensis, Sassafras variifolium, Corylus americana, Negundo aceroides, Prunus serotina, Tecoma radicans and Betula nigra,* in the Counties under consideration would attest.

On pages 75 and 76 is given a short abstract from Broadhead's notes on the trees and shrubs found in several Counties included in the survey. No attempt is made to give a complete list of the species observed. The following list enumerates 31 species of trees and shrubs observed, all perhaps correctly identified.

Asimina triloba, Alnus rugosa, Carpinus caroliniana, Celtis sp., *Carya ovata, C. amara, Corylus americana, Cercis canadensis, Fraxinus* sp., *Juglans nigra, J. cinerea, Morus rubra, Nyssa aquatica, Ostrya virginiana, Prunus* sp., *Platanus occidentalis, Quercus alba, Q. Muhlenbergii, Q. stellata, Q. velutina, Q. imbricaria, Q. macrocarpa, Q. rubra, Q. bicolor, Q. prinoides, Sassafras variifolium, Tilia* sp., *Ulmus americana, U. fulva, Vitis* sp., and *V. rotundifolia.*

That these lists of trees and shrubs observed by Swallow, Shumard and Broadhead, were not made from notes in the field, but probably from memory, is conclusively proven by the many omissions of conspicuous trees and shrubs which could not have been overlooked. Chief among these perhaps, in point of commercial value, utility and attraction, is the Yellow

Pine, *Pinus echinata,* which was abundant in many of the Counties of the Ozark Uplift; the Bald Cypress, *Taxodium distichum,* common in swamps along the Mississippi River from Cape Girardeau County to Pemiscot County; the Red Cedar, *Juniperus virginiana,* so common on bluffs and cliffs along rivers, and in cedar-glades in many of the Ozark Counties; the Cottonwood, *Populus virginiana,* often abundant in the deep bottoms of the Mississippi River from Saint Louis County to Pemiscot County; the Pecan, *Carya Pecan,* often very common along streams in southern Missouri, could scarcely have been overlooked; the Persimmon, *Diospyros virginiana,* so common in groves on the prairies of Southern Missouri; the Sweet Gum, *Liquidambar Styraciflua,* so common in bottoms, and so much sought after by saw-mill men for lumber; the Tupelo, *Nyssa uniflora,* abundant in swamps along the Mississippi River from Cape Girardeau County southward to Pemiscot County.

Among the more notable trees and shrubs of Southern Missouri which were of not much commercial importance, the following named could hardly have been overlooked in the field, and I do not see how these observers could have missed recording such conspicuous species as *Bumelia lanuginosa, Gymnocladus dioica, Quercus Michauxii, Q. lyrata, Q. aquatica, Fraxinus lanceolata, Ilex opaca, Viburnum rufidulum, Aralia spinosa, Rhamnus caroliniana, R. lanceolata, Robinia Pseudacacia, Malus* species, *Crataegus mollis, C. viridis, C. Phaenopyrum* and *Carya aquatica.*

On page 76 begins the Catalogue of Trees and Shrubs, ending on page 83, and enumerates 120 species of shrubby plants observed in the 32 Counties included in the survey, which is a very short list, considering that we now know more than five hundred species of woody plants for the State. This catalogue shows many evidences of haste, carelessness and negligence in its preparation, and it represents about as much work as could be done in several days by a trained collector.

For convenience of reference I have numbered the names in this catalogue, and will make notations on such species as

seem to me to merit this, and also call attention to some notable omissions of species that could hardly have escaped notice in making this survey.

1. COMMON ALDER, *Alnus serrulata.*

Swallow records this species from Newton, Lawrence and Taney Counties, but its known range in Missouri is from Lewis, Lincoln and Marion Counties to McDonald County, along the banks of rocky streams.

2. BLACK ALDER, OR WINTER BERRY.

I presume Swallow meant *Ilex verticillata* when he wrote that, but I can not believe he knew that species at the time, as it is very rare and local in Missouri. This species is listed in Tracy's Catalogue as having been found in Boone, Iron, Mississippi, and Pike Counties, but the records were so doubtful that I did not include it in my Trees, Shrubs and Vines of Missouri.

Perhaps Swallow had in mind *Rhamnus lanceolata* which is so often mistaken for *Ilex verticillata.*

Two trees that escaped Swallow's notice, *Rhamnus lanceolata* and *R. Caroliniana,* are common in many places in the Counties covered by this survey.

The strikingly conspicuous Holly, *Ilex opaca,* is common in some places in Pemiscot County, but Swallow overlooked it.

3. CRAB APPLE, *Malus coronaria.*

It is impossible now to tell which of the five or six species of *Malus* known to occur in Missouri that Swallow had, but it certainly was not *M. coronaria,* which is an eastern species.

4. WHITE ASH, *Fraxinus americana.*

Swallow merely cites Maries County for this species, but it is found in every County in Missouri, mostly in upland woods that are rather dry.

5. BLUE ASH, *Fraxinus quadrangulata.*

No particular locality is cited for this species, but it ranges from the northeast to the southwest corner of the State. Swallow overlooked the Green Ash, *Fraxinus lanceolata,* which is

common along all the streams in the State, and another species, *Forestiera acuminata*, is common from the Meramec River to Newton County, along the banks of streams. Another interesting tree, *Bumelia lanuginosa*, occurs in rocky upland woods in all the Ozark Counties.

Swallow negligently overlooked the Black Ash, *Fraxinus sambucifolia*, in his catalogue, for he lists this species in his remarks on timber on page 75.

6. PRICKLY ASH, *Zanthoxylum americanum*.

The habitat for this species is given by Swallow as bottoms and moist places, but I have usually found this shrub on dry wooded hills and in upland woods along streams. See No. 120.

7. AMERICAN LINDEN, *Tilia americana*.

At the time Swallow prepared his Catalogue it was supposed that all the glabrate Lindens of this State were *T. americana*, but I suspect that most of the trees observed by him were *T. alabamensis* Ashe, which is the common species of Southern Missouri.

The very peculiar shrub, *Dirca palustris*, common in many places in southern Missouri, Swallow evidently overlooked. Another interesting species, *Aralia spinosa*, found in Pemiscot County, was also overlooked by Swallow.

8. RED BIRCH, *Betula nigra*.

This species is common along streams from Clark County to McDonald County, but is absent in the Northwestern part of the State.

9. DEWBERRY, *Rubus canadensis*.

The common, widely diffused Dewberry, *Rubus flagellaris*, found throughout Missouri, undoubtedly was the species Swallow found.

10. WEDGE-LEAVED BLACKBERRY, *Rubus cuneifolius*.

I am unable to guess what species Swallow had in mind, but it certainly was not *R. cunefolius* which is a species of the

Southeastern States. Tracy in his catalogue credits this species to Pike County, on authority of Pech, but Pech evidently erred in naming his specimens or else he collected them in some other State.

11. BLADDER-NUT, *Staphylea trifolia.*

Common in nearly every County in the State, and no doubt correctly understood by Swallow.

12. LARGE BUCKEYE, *Aesculus lutea.*

Evidently based on trees of *Ae. glabra,* which is the common and abundant species throughout central Missouri. *Aesculus lutea* does not occur so far West as this State, although Tracy in his catalogue under the name of *Aesculus flava,* says it is common.

The conspicuous, scarlet-flowered species, *Ae. discolor mollis,* common in Pemiscot County and other Counties in southeastern Missouri, could hardly have been overlooked, and yet Swallow missed it.

13. HUCKLEBERRY, *Vaccinium* sp.

No doubt based on plants of the genus *Vaccinium,* more than likely on *V. stamineum,* which is not really a Huckleberry or even a Blueberry, and the only species this could be, as it is common on flint hills in all the Ozark Counties.

14. BLUEBERRY, *Vaccinium vacillans.*

Swallow says this is common on flint hills in Taney and Greene County, but it is common throughout the Ozark region. *V. arboreum,* also common throughout the Ozark Counties, seems to have been missed by Swallow.

15. BOX ELDER, *Negundo aceroides.*

Rightly understood by Swallow, and abundant in low ground throughout the State.

16. BURNING BUSH, *Euonymus atropurpureus.*

Also rightly understood by Swallow, and more or less common throughout the State in shaded ground along streams. Two other species of *Euonymus, E. americanus* and *E. obo-*

vatus, are more or less common in eastern and southern Missouri, particularly Pemiscot County.

17. SYCAMORE, *Platanus occidentalis.*

Common along all the streams of the State. See No. 96.

18. BUTTON BUSH, *Cephalanthus occidentalis.*

Swallow says this is not very abundant, but my observations have shown me that it is often abundant, especially in the lowlands and swamps along the Mississippi River from Cape Girardeau County southward, where I have seen hundreds of acres of it in one swamp. It is called Elbow Bush and Knee Bush by the hunters and fishers in that region.

19. RED CEDAR, *Juniperus virginiana.*

Common along limestone bluffs of the Mississippi and Missouri Rivers, and common in cedar barrens in all of the Ozark Counties.

20. BLACK CHERRY, *Prunus serotina.*

A common, often very large tree, of all parts of the State, especially in rich woods. Another species, the Choke Cherry, *Prunus virginiana*, ranging from Clark County south to Saint Louis and Benton Counties, mostly along streams, seems to have been overlooked by Swallow.

21. COFFEE TREE, *Gymnocladus canadensis.*

Common in rich woods, nearly throughout the state.

22. COTTON-WOOD, *Populus canadensis.*

A very large tree in the deep bottoms of the Missouri and Mississippi Rivers, rare or occasional in the prairie portions of the State and the Ozark Uplift. Another species, *Populus heterophylla*, overlooked by Swallow, occurs from Cape Girardeau County southward in the bottoms along the Mississippi River.

23. CORAL BERRY, *Symphoricarpos vulgaris.*

Common everywhere in the State, sometimes abundant in the prairie regions.

24. CURRANT, *Ribes* sp.

Swallow says several species, but none of them abundant, but he certainly must have been assuming this when he wrote that, as I have no knowledge of any species of Currant in the State. The only species of *Ribes* called Currant, is *R. odoratum*, which occurs along Swan Creek, Taney County, in one locality only. I can scarcely believe Swallow knew of this at that time. Tracy in his Catalogue says *R. odoratum* is common in rocky woodlands, but that was an error certainly, and I did not know this species for Missouri until 1899.

25. FLOWERING DOGWOOD, *Cornus florida.*

Common from Clark County to McDonald County, mostly in rocky woods.

26. PANICLED DOGWOOD, *Cornus paniculata.*

Common in rocky woods and barrens throughout the State.

27. ROUGH-LEAVED DOGWOOD, *Cornus asperifolia.*

Swallow says this species is not abundant, but my observations have shown me that in the big bottoms along the Missouri and Mississippi Rivers it is very abundant, and it is common along all the streams in the State.

28. SILKY DOGWOOD, *Cornus sericea.*

Common along all the streams in the State, but now known as *C. obliqua* Raf. Another species, *Cornus alternifolia*, was missed by Swallow. It occurs from Clark County to the southwestern corner of the State, mostly along rich shaded bluffs along streams. Still another species, *Cornus stricta*, common in swamps in Pemiscot County, was overlooked by Swallow.

29. COMMON ELDER, *Sambucus canadensis.*

Common throughout the State in low grounds, often tree-like in the southeastern Counties, where the stems sometimes attain a diameter of three or four inches.

30. WHITE ELM, *Ulmus americana.*

Found throughout the State in rich soil. Often of immense size, often six or seven feet in diameter.

31. SLIPPERY ELM, *Ulmus rubra.*

Common everywhere in the State, usually in dry or rocky ground.

32. WAHOO ELM, *Ulmus alata.*

Swallow cites this species for Greene County, "scarce, limestone ridges," but this tree is found throughout southern Missouri, and is very common in most Counties, of large size in Pemiscot County, where it seems to prefer swamps and low ground, and usually a tree of good size in McDonald County, but in the Ozark Uplift seems to prefer high rocky ridges and is usually quite shrubby.

33. SUMMER GRAPE, *Vitis aestivalis.*

Swallow says abundant on good soil, but I have never seen this species abundant anywhere in the State or even common. I am assuming that Swallow knew the Summer Grape, unless he mistook *Vitis Linsecomii glauca* for it, as the latter is often common in rocky woods in Southern Missouri.

34. FOX GRAPE, *Vitis Labrusca.*

It is very clear that the plants Swallow had in mind were not *V. Labrusca,* but it is quite likely that they were *V. aestivalis,* which is often mistaken for *V. Labrusca* by inexperienced collectors, or *V. Linsecomii,* the latter common in some places in Newton and McDonald Counties in rocky woods.

35. WINTER GRAPE, *Vitis cordifolia.*

Probably correctly identified.

36. MUSCADINE, *Vitis vulpina.*

Not found in Missouri outside of the southeastern Counties, where it is occasionally found in uplands.

37. RIVER GRAPE, *Vitis riparia.*

Probably the plant we now know as *V. vulpina* L., but the habitat is not river banks particularly, and I suspect that the Slough Grape, *V. vulpina praecox* (Engelm.) Bailey, is what Swallow had in mind. Two species of *Vitis* enumerated on page 16, *V. binnata* and *V. indivisa,* are not included in this

catalogue, nor are *V. rupestris*, and *V. rubra*, the former common from Saint Louis County to McDonald County, in rocky or sandy creek beds, the latter common in swamps from Saint Louis County southward along the Mississippi River in swamps.

38. GREEN BRIER, *Smilax rotundifolia.*

Probably correctly identified, but another species, *S. hispida*, even more conspicuous, is not mentioned by Swallow, who must have seen it along some of the rivers where he made the survey.

39. GLAUCOUS GREEN BRIER, *Smilax glauca.*

The habitat given for this species causes me to suspect that Swallow did not have the real *S. glauca* in hand at that time, and most probably mistook plants of *S. rotundifolia* for that species, as the real *S. glauca* is a species of the lowlands of southeastern Missouri, and is called Saw Brier by the natives.

40. *Smilax Pseudo-China.*

I can not imagine what species of *Smilax* Swallow had in mind at that time, as it has been shown that *S. Pseudo-China* is only a form of *S. herbacea*, and *S. herbacea* is an annual-stemmed species and not at all shrubby. As Swallow does not mention *S. hispida*, and Shumard and Broadhead also fail to enumerate it, I venture the guess that Swallow mistook specimens of this species for S. *Pseudo-China.*

41. *Smilax Bona-nox.*

Swallow says this is abundant on shrubs by the fences, but he evidently had some other species in hand, as this species is found only in the extreme southeastern part of the State in cotton fields. Probably only some form of *S. rotundifolia*, which is common in southern Missouri.

42. *Smilax quadrangularis.*

It is very evident that this is only *S. rotundifolia*, the common species in southern Missouri.

43. *Smilax hastata.*

Evidently the same as No. 40, and no doubt based on specimens of *S. rotundifolia,* which is so common in southern Missouri.

44. PRICKLY GOOSEBERRY, *Ribes Cynosbati.*

Swallow says this is abundant, but I have never seen this species common anywhere, as my observations have shown me that it is rare or local on shaded bluffs along streams. Probably Swallow had the common species, *R. gracile,* in hand, since he, Shumard and Broadhead do not enumerate it in their lists, and it is the common species throughout Missouri, and could not have been overlooked.

45. WILD GOOSEBERRY, *Ribes rotundifolia.*

It is very evident that Swallow did not observe this species, and it is not known now from the State, although Tracy has it in his Catalogue in 1886. I am inclined to believe Swallow had *R. gracile* in hand at the time he wrote his catalogue, as that is the common species everywhere in the State.

A large conspicuous tree, the Sweet Gum, *Liquidambar Styraciflua,* evidently neglected by Swallow, could not have been overlooked, as it is common in eastern and southeastern Missouri in sandy bottoms along the Mississippi River. A peculiar shrub, *Hydrangea arborescens,* seems to have been missed by Swallow. It is common in eastern and southeastern Missouri along rich bluffs in the shade.

46. BLACK GUM, *Nyssa multiflora.*

Swallow cites Maries County only for this species, but it occurs from Cape Girardeau County southward and westward to Newton and McDonald Counties. The Tupelo, *Nyssa aquatica,* appears to have been overlooked by Swallow, but it ranges in Missouri from Cape Girardeau County southward along the Mississippi River, in swamps and about ponds.

47. HACKBERRY, *Celtis occidentalis.*

Probably correctly identified as the tree we now know as

C. occidentalis canina, which is the common, large tree throughout the State.

48. HACKBERRY, *Celtis crassifolia*.

There is no evidence that this is the real *C. crassifolia*, and it very probably was the same species as No. 47. The smooth-barked Hackberry, *Celtis laevigata*, seems to have been overlooked by Swallow. It occurs all over Southern Missouri, mostly along streams in rich bottoms.

49. AMERICAN HAZEL, *Corylus americana*.

Probably correctly identified.

50. BLACK HAW, *Viburnum prunifolium*.

Swallow says occurs in open forests in good soil, but he must have had *V. rufidulum* in hand then, since he does not mention that species, which is common in southern Missouri in open woods, while *V. prunifolium* occurs mostly along the banks of rocky streams, and in copses on the prairies.

51. RED HAW, *Crataegus* sp.

By this indefinite term I am supposing that Swallow must have had some edible-fruited species of Thorn in hand, of the *molles group*, or even the *tomentosae* group, but it is impossible at this time to tell which species he had. See remarks under Thorn further on.

52. MOCKERNUT HICKORY, *Carya tomentosa*.

Probably correctly determined.

53. SHELLBARK HICKORY, *Carys alba*.

Swallow says this is not common, but I have found it to be common, almost abundant, on dry hills along streams in the eastern part of the State.

54. THICK SHELLBARK HICKORY, *Carya sulcata*.

No doubt correctly identified.

55. PIGNUT HICKORY, *Carya porcina*.

Swallow says rare on good soil, but I doubt very much if Swallow ever saw the real *C. porcina*, and suspect that some

form of *C. ovalis* must have been seen by him and identified as *C. porcina.*

56. BULLNUT HICKORY, *Carya microcarpa.*

This is probably what we now have as *C. ovalis,* or one of the forms of it, as it is common in just such association as Swallow gives it.

57. BITTERNUT HICKORY, *Carya amara.*

Swallow cites this species from Caps Creek, Newton County, which would seem to signify that it was rare in Missouri, but this species occurs in woods along streams throughout the State. The Pecan, *Carya Pecan,* seems to have been carelessly neglected in this Catalogue. Neither does Shumard or Broadhead mention it in their reports, but it would have been impossible to overlook this tree in the field, as it occurs from Saint Louis to Newton County along streams. Another very interesting species, *Carya aquatica,* found in swamps along the Mississippi from Cape Girardeau County to Pemiscot County, but Swallow does not mention it in this report.

58. YELLOW HONEYSUCKLE, *Lonicera flava.*

It is barely possible that Swallow did find this rare and attractive species, as it really is found in Taney County.

59. SMALL-FLOWERED HONEYSUCKLE, *Lonicera parviflora.*

Probably correctly identified. Another species, and one still more attractive, *Lonicera sempervirens,* occurs in many of the Counties from Saint Louis County to Newton County, mostly along streams.

60. HOP HORNBEAM, *Ostrya virginica.*

Correctly identified.

61. IRONWOOD, *Carpinus americana.*

Also correctly identified.

62. RED BUD, *Cercis canadensis.*

Correctly identified.

63. HONEY LOCUST, *Gleditschia triacanthos.*

No doubt correctly identified. The Water Locust, *G. aquatica,* ranging from Cape Girardeau County to Pemiscot County in swamps along the Mississippi River, seems not to have been observed by Swallow. The Black Locust, *Robinia Pseudacacia,* seemingly native on the hills and knobs of Newton and McDonald Counties, seems also to have escaped notice by Swallow. The abundant little shrub along all the streams in the Ozark Counties, *Amorpha fruticosa,* also seems to have been neglected by Swallow, and the very conspicuous little Lead Plant, *Amorpha canescens,* abundant in south Missouri in rocky barrens, on prairies, and in dry oak woods, seems to have been overlooked also.

64. WHITE MAPLE, *acer eriocarpum.*

No doubt correctly identified.

65. SUGAR TREE, *Acer nigrum?*

Probably this species, unless it should have been some form of *A. barbatum,* of which several forms occur in many of the Counties in Southern Missouri. From Cape Girardeau County, southward along the bluffs of the Mississippi River, occurs ACER BARBATUM RUGELII (Pax) n. comb. (*A. saccharum Rugelii* (Pax) Rehder). Another form, A. BARBATUM SCHNECKII (Rehder) n. comb. (*A. saccharum Schneckii* Rehder), common in several Counties in Southern Missouri, as well as in Pemiscot County. Still more common in eastern Missouri is ACER BARBATUM GLAUCUM (Sargent) n. comb. (*A. saccharum glaucum Sargent*). I can not see how Swallow could have missed seeing *A. rubrum,* common along streams from Saint Louis County to Greene County, but he does not mention it. Another conspicuous species, *A. Drummondii,* common in swamps, from Cape Girardeau County southward along the Mississippi River, also seems to have escaped the notice of Swallow. On the hills bordering the swamps in Cape Girardeau County is still another tree, *A. rubrum tridens,* not noticed by Swallow.

66. RED MULBERRY, *Morus rubra.*

Probably correctly identified.

67. OSAGE-ORANGE, *Maclura aurantiaca.*
Probably correctly identified.

68. WHITE OAK, *Quercus alba.*
Correctly identified.

69. BUR OAK, *Quercus macrocarpa.*
Correctly identified.

70. POST OAK, *Quercus obtusiloba.*
Correctly identified.

71. SWAMP WHITE OAK, *Quercus bicolor.*
Probable correctly identified, as this species is common in all the Counties in eastern Missouri.

72. CHESTNUT WHITE OAK, *Quercus Prinus.*
It is quite certain that Swallow mistook some other species of oak for this, probably some form of *Q. Muhlenbergii*, as there is no evidence that *Q. Primus* has ever been found in Missouri.

73. ROCK CHESTNUT OAK, *Quercus monticola.*
Obviously the same thing as No. 72.

74. CHESTNUT OAK, *Quercus acuminata.*
Correctly identified and no doubt the same species we now know as *Q. Muhlenbergii.*

75. CHINQUAPIN OAK, *Quercus prinoides.*
I am unable to say what it was that Swallow had in hand when he wrote that, but the name *Chinquapin Oak* more properly belongs to *Q. Muhlenbergii*, which is often found on limestone bluffs.

76. LAUREL OAK, *Quercus imbricaria.*
No doubt the same tree that we know as Shingle Oak, as the name Laurel Oak more properly belongs to *Quercus laurifolia*, a species of the Southeastern States.

77. BLACK JACK OAK, *Quercus nigra.*
Correctly identified.

78. BLACK OAK, *Quercus tinctoria.*
Probably correctly identified.

79. SCARLET OAK, *Quercus coccinea.*
I can scarcely believe that Swallow knew the Scarlet Oak, since many years were spent by trained collectors seeking for it, and it was only a few years ago that it was definitely proven to occur in the State.

80. RED OAK, *Quercus rubra.*
Probably correctly identified.

81. PIN OAK, *Quercus palustris.*
Probably correctly identified.

82. GRAY OAK, *Quercus ambiqua.*
I suspect this is only a form of the Red Oak, but there is nothing to decide this now.

83. SPANISH OAK, *Quercus falcata.*
Swallow states that this species is found in the south-west part of the state, but that is certainly a mistake, as the Spanish Oak occurs only in the southeastern Counties, New Madrid, Dunklin, Butler and Pemiscot Counties. It is likely that Swallow found some form of *Q. velutina* in Southwestern Missouri, which there assumes some very puzzling forms, and the country people call this species Spanish Oak, Slick Oak, Turkey Oak, Shin Oak and other names. It will be noted that Swallow lists sixteen species of oaks for the whole territory covered by the survey, but of these there are certainly four names that are synonyms of other names, or are names of species not known to occur in the State. In Dunklin County, which adjoins Pemiscot County, I once collected sixteen species of oaks in one place, on what is known as the tenth section, a tract of 640 acres. Several species of *Quercus* of interest, seem to have been overlooked by Swallow which seems quite unaccountable. Principal among these are the Cow Oak, *Q. Michauxii*, *Q. lyrata* and *Q. Shumardii*, all ranging from Cape Girardeau County southward along the Mississippi River in

low swamps. Another conspicuous tree, the Chinquapin, *Castanea ozarkensis,* seems also to have been neglected by Swallow in his Catalogue, but is common in Barry and McDonald Counties. Still another conspicuous tree, the Beech, *Fagus grandifolia,* common on high sandy hills from Cape Girardeau County to Pemiscot and Dunklin Counties, and it seems unaccountable how Swallow could have overlooked it.

84. PAWPAW, *Asimina triloba.*

Correctly determined. The conspicuous tree, the Cucumber Tree, *Magnolia acuminata,* occurs in several of the Counties in Southern Missouri, particularly in Barry County along the bluffs of the White River, but Swallow does not mention it in his Catalogue. Still another large tree, the Yellow Poplar, *Liriodendron Tulipifera,* of conspicuous appearance, occurs on high sandy hills from Cape Girardeau County to Pemiscot County and yet Swallow neglected to include it in his Catalogue.

85. PERSIMMON, *Diospyros virginiana.*

Swallow says this is scarce in Southwest Missouri, but my observations show that it is common on the prairies of that part of the State, often abundant in groves.

86. YELLOW PINE, *Pinus mitis.*

Swallow cites this from Crawford, McDonald and Washington Counties only, but it occurs in all the Ozark Counties in Southern Missouri. A very conspicuous tree, the Bald Cypress, *Taxodium distichum,* seems to have been overlooked by Swallow in his Catalogue, but it is common in swamps from Cape Girardeau County southward along the Mississippi River bottoms.

87. RED PLUM, *Prunus americana.*

I am unable to guess what species Swallow had in hand, but it could scarcely have been *P. americana,* which I have never seen in Southern Missouri.

88. CHICKASAW PLUM, *Prunus Chicasa.*

Probably Swallow had what is now known as *P. Munsoniana,* which is common from Saint Louis County to Newton County, and not the Chickasaw Plum, which is rather uncommon in Southern Missouri.

89. PRICKLY ASH, *Zanthoxylum americanum.*

Swallow lists this species twice. See No. 6.

90. RATAN, *Wistaria frutescens.*

Evidently the species we now know as *W. macrostachys,* which at the time Swallow was writing his catalogue had not been distinguished from *W. frutescens,* but I am not certain by any means that Swallow intended to write *Wistaria frutescens* for the Ratan, as this name belongs to *Berchemia scandens,* a high-climbing, tough vine of Southern Missouri, which Swallow does not mention in this report.

91. PRAIRIE ROSE, *Rosa setigera.*

Correctly identified.

92. SMOOTH ROSE, *Rosa blanda.*

Swallow says this species was observed during the survey, but there can be no doubt that he must have had some other species in hand, probably *R. Bushii,* which occurs in southern Missouri, or *R. heliophila,* which is also common there.

93. SHINING ROSE, *Rosa lucida.*

Swallow says this species also was seen, but I suspect he must have had *R. carolina* in hand at that time, as it is most often mistaken for *R. lucida,* and he does not mention *R. carolina* in his Catalogue. The Swamp Rose, *Rosa palustris,* found from Cape Girardeau County southward along the Mississippi River bottoms in swamps, seems not to have been seen by Swallow.

94. RED RASPBERRY, *Rubus strigosus.*

It is very evident that Swallow mistook some form of the common Black Raspberry for this species, as *R. strigosus*

does not occur in Southern Missouri, or anywhere else in the State so far as I have been able to learn.

95. BLACK RASPBERRY, *Rubus occidentalis.*

Evidently correctly identified and the same as the last species.

96. BUTTONWOOD, *Platanus occidentalis.*

Swallow listed this species twice in the Catalogue. See No. 17.

97. DWARF SUMACH, *Rhus copallina.*

Evidently correctly identified.

98. SMOOTH SUMACH, *Rhus glabra.*

Probably correctly identified.

99. STAGHORN SUMACH, *Rhus typhina.*

Swallow very evidently was mistaken in listing this species, as it is not known to occur in the State, and I suspect that the tree-like forms of *R. copallina* on the prairies of Southwestern Missouri were mistaken for this species.

100. POISON IVY, *Rhus toxicodendron.*

Probably correctly identified.

101. FRAGRANT SUMACH, *Rhus aromatica.*

Evidently some species of the genus that is now sometimes called *Schmaltzia,* but I am unable to say which one it was. The very conspicuous, small tree, *Cotinus americanus,* was overlooked by Swallow, but it is common along the bluffs of Swan Creek, Taney County, a locality where Swallow collected, and one he mentions in several places, as under Witch Hazel, Huckleberry, Blueberry, Honeysuckle and Wild Service Berry.

102. NINE-BARK, *Spiraea opulifolia.*

Probably correctly identified, and what we now know as *S. intermedia,* which has the follicles permanently pubescent.

103. *Spiraea corymbosa.*

I am unable to say what species Swallow had in hand at

that time, as it is pretty certain that *S. corymbosa* does not occur in the State. In some later report Swallow cites this species for Putnam County, but this must have been *S. alba*, which is known to occur in Putnam County.

104. SASSAFRAS, *Laurus Sassafras*.

Swallow says the Sassafras is not common, but in this he certainly erred, as it not only is common in southern Missouri, but often abundant. The Spice-bush, *Lindera Benzoin*, so common along streams in Southern Missouri, seems not to have been seen by Swallow, or else he neglected to include it in his Catalogue.

105. SARSAPARILLA.

I am unable to say just what plant Swallow had in mind when he wrote that, as the name is applied to two very different plants, one the Moonseed, *Menispermum canadense*, a suffrutescent vine with long yellow roots, which is called Parilla or Sarsaparilla, by the country people. The other, *Smilax herbacea*, which is not shrubby at all. In either case the listing of this plant by Swallow is to be regretted, as there are so many more noticeable trees and shrubs that he could have listed, and which he neglected to include in his Catalogue, one of which may be appropriately mentioned here, the Mistletoe, *Phoradendron flavescens*, so common in trees in many of the Counties of Southern Missouri.

106. WILD SERVICE BERRY, *Amelanchier canadensis*.

Probably correctly identified.

107. STAFF-TREE, *Celastrus scandens*.

No doubt but correctly identified, but the name Staff-Tree is not only a misnomer on account the species not being a tree, but the country people call this vine Bittersweet. The Staff-Tree is an European species.

108. BLACK THORN, *Crataegus tomentosa*.

I am unable to say what species of *Crataegus* Swallow had in hand, but it is very unlikely that it was *C. tomentosa*, which is an eastern species.

109. RED HAW, *Crataegus coccinea.*

I am making a guess that Swallow found *C. mollis,* the abundant species throughout Missouri, which he does not mention in this Catalogue, and identified it as *C. coccinea,* but *C. coccinea* is an eastern species.

110. DOTTED THORN, *Crataegus punctata.*

There is no way of telling now what species Swallow had in hand then, but it certainly was not *C. punctata,* which is an eastern species.

111. CRATAEGUS CRUS-GALLI.

It is very improbable that Swallow found the real *C. Crus-galli* at that time, but very likely he had some species of the *Crus-galli* group.

112. CRATAEGUS SPATHULATA.

No doubt wrongly identified, as *C. spathulata* does not occur in any of the Counties in which the survey was made, in such numbers as to likely be found.

113. CRATAEGUS APIIFOLIA.

Swallow undoubtedly made a mistake in identifying this as *C. apiifolia,* as *C. apiifolia* is not known to occur only in the extreme southern part of Dunklin and Ripley Counties, and I suspect that Swallow must have seen *C. cordata,* which occurs in many of the Ozark Counties and mistook it for *C. apiifolia.*

114. TRUMPET CREEPER, *Tecoma radicans.*

Probably correctly identified. The very attractive Crossvine, *Bignonia capreolata,* often found in some of the Counties in Southeastern Missouri, seems not to have been seen by Swallow. The handsome and attractive Catalpa, *Catalpa speciosa,* was also neglected by Swallow in his Catalogue, but he could hardly have overlooked this tree in the field as it is often seen in swamps in many of the Counties in Southeastern Missouri.

115. VIRGINIAN CREEPER, *Ampelopsis quinquefolia.*
Probably correctly determined.

116. BLACK WALNUT, *Juglans nigra.*
Correctly determined.

117. WHITE WALNUT, *Juglans cinerea.*
Correctly determined.

118. SALIX.
Swallow says several species were observed, but he does not cite any species, although several species are abundant along streams.

119. WINTER-BERRY, *Prinos laevigata.*
I am unable to say what it was that Swallow had in hand, as it is pretty certain that it was not *Ilex laevigata,* which is an eastern species.

120. WITCH-HAZEL, *Hamamelis virginiana.*
Cited from Swan Creek, Taney County only, but this species is common to nearly all the Counties in the southern part of the State and is what we now know as *H. vernalis,* a species that flowers in the Spring, having many stems springing from the root, which never make trees, the true Witch-hazel having single stems that assume more or less tree-like forms.

THE STRATIGRAPHY AND LARGER FOSSILS OF THE PLATTIN FORMATION IN STE. GENEVIEVE COUNTY, MISSOURI [1, 2]

By CARROLL LANE FENTON

IV. PALEONTOLOGY

Study of the fossils of the Plattin and Decorah formations of Ste. Genevieve County has extended only to the larger, more typical and more readily identifiable forms. These make up but a small part of the faunas, but the collections represent the lesser types so inadequately that work on them at present is impossible.

Two Plattin species, *Rhynchotrema cuneiforme* and *Zygospira variabilis*, have been described in an earlier paper.[3] Members of the genus *Strophomena*, on the other hand, are left to a later one, in which species from the Decorah of Minnesota and two from the Richmond of the Ohio valley will be introduced for comparison.

Finally, I must repeat a caution already stated: that in statements of occurrence the qualifications middle, lower and upper refer only to the Plattin strata of Ste. Genevieve County, not to the formation as a whole.

BUTHOTREPHIS REGULARIS N. SP.

PLATE I, FIG. 1.

Description.—Stems cylindric or subcylindric, 7 to 8 mm. in diameter, and tapering gradually. Each of the three stems

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1 Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 3.

2 Continued from page 96, Vol. XI, No. 2.

3 C. L. Fenton and M. A. Fenton, Proc. Ia. Acad. Sci., vol. 29, pp. 67-84. 1923. (Not 1922, as printed on title page of the volume.)

in the holotype bears evenly spaced branches whose diameter is about half that of the main stem. Each branch is constricted at its origin. Surface apparently smooth.

Remarks.—This form is distinguished by its regularly spaced branches, and by their constriction.

Occurrence.—Number 14 of the Plattin, near the north end of South Beckett Hill.

BUTHOTREPHIS BRACHIATUS N. SP.

PLATE I, FIGS. 2-3.

Description.—Stems cylindric or subcylindric, repeatedly bifurcating, with blunt terminations. Diameter of stems 4.5 to 7.5 mm.; maximum length between bifurcations, among the specimens at hand, 61.6 mm.

Remarks.—This form is with some doubt referred to the genus *Buthotrephis*. The habit of bifurcate branching is its most distinctive character.

Occurrence.—Number 24 of the Plattin of South Beckett Hill; probably in higher beds as well.

BUTHOTREPHIS SP.

PLATE I, FIG. 4.

From Number 14 of the Plattin, near the north end of South Beckett Hill, comes a specimen of *Buthotrephis* whose characters are shown in the figure. The surface appears to be marked by shallow pits, though the appearance may be merely a result of weathering. Fucoidal casts of a type similar to this are common throughout the basal fifteen members of the Plattin.

PALEOPHYCUS TUBULARE HALL

PLATE I, FIG. 5.

Paleophycus tubuluris Hall, Pal. N. Y., vol. 1, p. 7, pl. 2, figs. 1-2, 4-5. 1847.

Description.—Stems terete, infrequently branched, subcylindric; surface nearly smooth. In the specimen figured, the stem is slightly flexuous, while its tapering character is not distinguishable. The diameter ranges from 15 to 18 mm.

Remarks.—This cast closely resembles the one shown by Hall in Fig. 1 of the reference given. Identification must be uncertain, of course, but the similarities of the specimens from New York and Missouri seem great enough to warrant use of Hall's name for the latter.

Occurrence.—Number 15 of the Plattin, near the north end of South Beckett Hill.

DYSTACTOSPONGIA MINOR ULRICH AND EVERETT

NOT FIGURED.

Dystactospongia minor Ulrich and Everett, Geol. Surv. Ill., vol. 8, page 278, pl. 8, figs. 3 a-b. 1890.

Dystactospongia minor Hayes and Ulrich, U. S. Geol. Surv., Folio 95, illust. sheet, figs. 48-49. 1893.

Description.—Sponge massive, lobate or subconical; composed of tubes which radiate from the base to the upper surface, where they show diameters ranging from .5 to .9 mm. The average thickness of the tube-walls is about .2 mm., though Ulrich and Everett mention walls .4 mm. thick. At the surface several tubes commonly coalesce.

In vertical section the tube-walls are seen to thicken toward the base, and are pierced by large, irregular openings. Some of them have been traced for 27.5 mm. without showing appreciable change in diameter. In the holotype the canal cavities are traversed by branching or simple fibers of calcite which probably represent spicules. No trace of these has been found in the silicified specimens from Missouri.

Remarks.—The tubes of specimens from Ste. Genevieve County are larger and somewhat more distinct than those of the holotype but are essentially like those of the specimens illustrated by Hayes and Ulrich.

Occurrence.—Platteville of Dixon, Ill.; Carters limestone

of the Columbia Quadrangle, Tenn.; Plattin of St. Genevieve Co., where it is abundant in numbers 32 to 35, and common in other strata from 22 to 38.

STREPTELASMA CORNICULUM MEDIUM N. VAR.

PLATE II, FIGS. 5-7.

Description.—Corallum much like that of *S. corniculum* Hall, but smaller and less curved. The largest specimen observed has a diameter of 23 mm. and a height of 29.17 mm.

The calyx is intermediate in depth between those of *S. corniculum* and *S. profundum*. Septa alternating; 30 to 36 of each series in medium or large specimens; as few as 24 in small ones. They commonly are twisted at the center, and in a few specimens form weak pseudocolumellae. Specimens from the operculum bed are larger, and have slightly shallower calyces than do those from other horizons.

Remarks.—It seems probable that the specimens figured by Winchell and Schuchert (Geol. Minn., vol 3, pt. 1, pl. G., figs. 20-21) belong to this variety, which perhaps might properly be called a race of *S. corniculum*.

Occurrence.—Platteville, Mineral Point, Wis., and probably other localities; Plattin of Ste. Genevieve County, Mo. Here it is generally distributed above Number 20 of the section, and is abundant in number 32.

COLUMNARIA HALLI NICHOLSON

PLATE II, FIGS. 1-2.

Columnaria (?) *halli* Nicholson, Tabulate Corals Pal. Per., p. 200, fig. 29; pl. 10, figs. 3-3a. 1879.

Columnaria (?) *halli* Winchell and Schuchert, Geol. Minn., vol. 3, p. 85, pl. G, figs. 14-16. 1893.

Description.—Corallum massive, flattened or depressed hemispherical. Corallites generally irregularly hexagonal, and highly variable in size; their maximum diameters range from 1.5 to nearly 6 mm. Septa short, heavy, continuous. Tabulae

strong, horizontal and complete, numbering 8 or 9 in the space of 10 mm.

Remarks.—The Missouri specimens of *C. halli* form smaller masses than those from New York, but larger than those from the Platteville of Minnesota. The septa are shorter than in High Bridge specimens identified as *C. halli*, but no other significant differences appear.

Occurrence.—In the Plattin of Ste. Genevieve County, *C. halli* ranges from the lower members to the top of the formation, but is most abundant in Number 24 of the general section.

MONOTRYPA MAGNA ULRICH

PLATE II, FIGS. 3-4.

Monotrypa magna Ulrich, Geol. Minn., vol. 3, pt. 1, p. 304, pl. 27, figs. 28-29. 1893.

Description.—Zoarium typically subhemispherical, but in some cases massive with sharp processes; 10 to 150 mm. in diameter. Zooecia polygonal, 0.4 to 0.8 mm. in diameter, the average being about 0.5 or 0.6 mm. Walls thin to thick, smooth to crenulate in vertical sections. Diaphragms 0.2 to 8 mm. apart, but rarely more than 3 mm.; in many specimens they lie rather uniformly along discernible levels, and even give a false appearance of laminae. This character commonly is most marked in regular, subhemispherical masses.

Remarks.—Ulrich lists as additional characters, a clustering of the larger zooecia and (generally) the presence of a wrinkled epitheca. Neither of these features appear in specimens from Ste. Genevieve County, where zooecial walls are heavier and less undulating, and whose zooecia seem to be larger than those which Ulrich figures. They also show more regular arrangement of the diaphragms.

This last character makes the species suggest a very small-celled member of the genus *Dania* of Milne-Edwards and Haime. The original figure of the latter, however, seems to be highly diagrammatic, and the resemblance may be less sub-

stantial than it seems. Yet it serves to emphasize the uncertainty of the boundary separating the tabulate "corals" from the Bryozoa.

Occurrence.—Platteville formation at Dixon, Ill., and Mineral Point and Beloit, Wisconsin; Plattin at House Springs, Mo., and in Ste. Genevieve County, where it is especially common in Number 32 of the general section.

RAFINESQUINA MINNESOTENSIS (N. H. WINCHELL)

PLATE II, FIG. 8.

Strophomena minnesotensis Winchell, 9th Ann. Rep. Geol. Nat. Hist. Surv. Minn., p. 120. 1881.

Rafinesquina minnesotensis Winchell and Schuchert, Geol. Minn., vol. 3, pt. 1, p. 401, pl. 31, figs. 25-29. 1893.

(For additional bibliography see Bassler, Bull. 92, U. S. Nat. Mus.)

Description.—Shell of medium size. Dimensions of two brachial valves and one pedicle: length 22.5, 21.5 and 20.3 mm.; width 26.5, 26 and 25.5 mm. Convexity of two brachial valves, about 5 and 6 mm., the former being the specimen of which other measurements have been given.

Pedicle valve moderately convex in the umbonal region, increasingly so medially, and somewhat flattened posterolaterally. Cardinal area 1 to 2 mm. in height, slightly concave; beak protruding but not recurved. Cardinolateral extremities generally slightly produced in mature specimens, though not in young. Diductor scars large, together forming nearly a circular area; their margins are but slightly elevated. Adductor scars located on a low rounded ridge which in some specimens is produced into a median septum. A low ridge runs from 3 to 4.5 mm. within the lateral margins, turning centrally and fusing with the posterior margin, whose internal characters are not preserved in the molds available for study.

Brachial valve slightly concave, flattened over most of its surface, and reflected near the margin. Within the margin is a shallow linear impression; between this and the margin

is a heavy ridge crossed by vascular channels. In the center of the valve are smooth, abrupt, digitately radiating ridges, the middle one of which extends to the depression within the margin, or disappears upon the visceral disc. The others rise and enlarge abruptly, terminating anteriorly in abrupt enlargements; none of them reach the umbonal region. Hinge plates short and widely divergent; behind them are small, double-grooved sockets. The beak, according to Winchell and Schuchert, is perforate.

Remarks.—This form appears to be derived from *R. incrassata* (Hall), found in Chazyan of New York and eastern Tennessee. From Sardeson's variety *inquassa* the typical *R. minnesotensis* differs in its lesser convexity and greater proportion of length to width.

Among the Missouri specimens there is some variation, apparently in accordance with age. The smaller specimens are subquadrate in outline and lack the strong median ridge which characterizes the brachial valve of the larger individuals, and the border ridge is but slightly developed. With increasing size, however, these differences disappear.

Occurrence.—Decorah ("Trenton Shales") of St. Paul, Cannon Falls and Fountain, Minnesota, and Decorah, Iowa; Platteville of St. Paul, Minnesota, Janesville and Beloit, Wisconsin, and Rockton and Dixon, Illinois; Black River of Kentucky and Tennessee. In Ste. Genevieve County, Missouri, *R. minnesotensis* is found in the middle Plattin (No. 15) and extends nearly to the top of the formation. It seems to be dominantly a Platteville-Plattin form, and indentifications of it from the Decorah are open to question.

DINORTHIS DEFLECTA GIBBOSA N. VAR.

PLATE V, FIGS. 2-9.

Description.—Shell of medium size: length .70 to .85 of the width; extremities commonly rounded. Dimensions of a pedicle and two brachial valves: length 20, 17.4 and 17 mm.; width 27.7, 23 and 20.1 mm.

Pedicle valve convex umbonally, concave medially. Umbonal fold replaced anteriorly by a poorly defined sinusal depression which fails to appear in young shells. In older ones growth lamellae are fairly common, often forming a strong external intramarginal ridge. Cardinal extremities sharply convex. Brachial valve convex umbonally and less so anteriorly, with recurved extremities. Mesial depression marked umbonally, but faint in the anterior region. Growth lamellae appear 12 to 14 mm. anterior to the beak; they are massed, and commonly heavy. Internal characters shown by the figures.

Remarks.—Only those characters have been mentioned which serve to distinguish the form *gibbosa* from the typical *D. deflecta* as figured by Hall, Hall and Clark and Winchell and Schuchert. The greater length and convexity and persistently rounded extremities, even in young shells, are diagnostic characters.

From the fact that Winchell and Schuchert mention shells whose hinge lines are "two-thirds, or as long as, the greatest transverse diameter of the shell," it may be assumed that the form *gibbosa* occurs in other regions than Ste. Genevieve County. However, its prevalence there probably entitles it to rank as a geographic race. Without a much larger series of specimens than is available, however, the point cannot be determined.

Occurrence.—Plattin of Ste. Genevieve Co., Mo., particularly in the operculum bed (number 37) on South Beckett Hill. Probably in other Black River strata of the Mississippi Valley.

PIANODEMA SUBAEQUATA (CONRAD)

PLATE III, FIGS. 13-15.

Orthis subaequata Conrad, Proc. Acad. Nat. Sci. Phila., vol. 1, p. 333. 1843.

Dalmanella subaequata Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, pp. 194, 207, 224, pl. 5 C, Figs. 6-11. 1892.

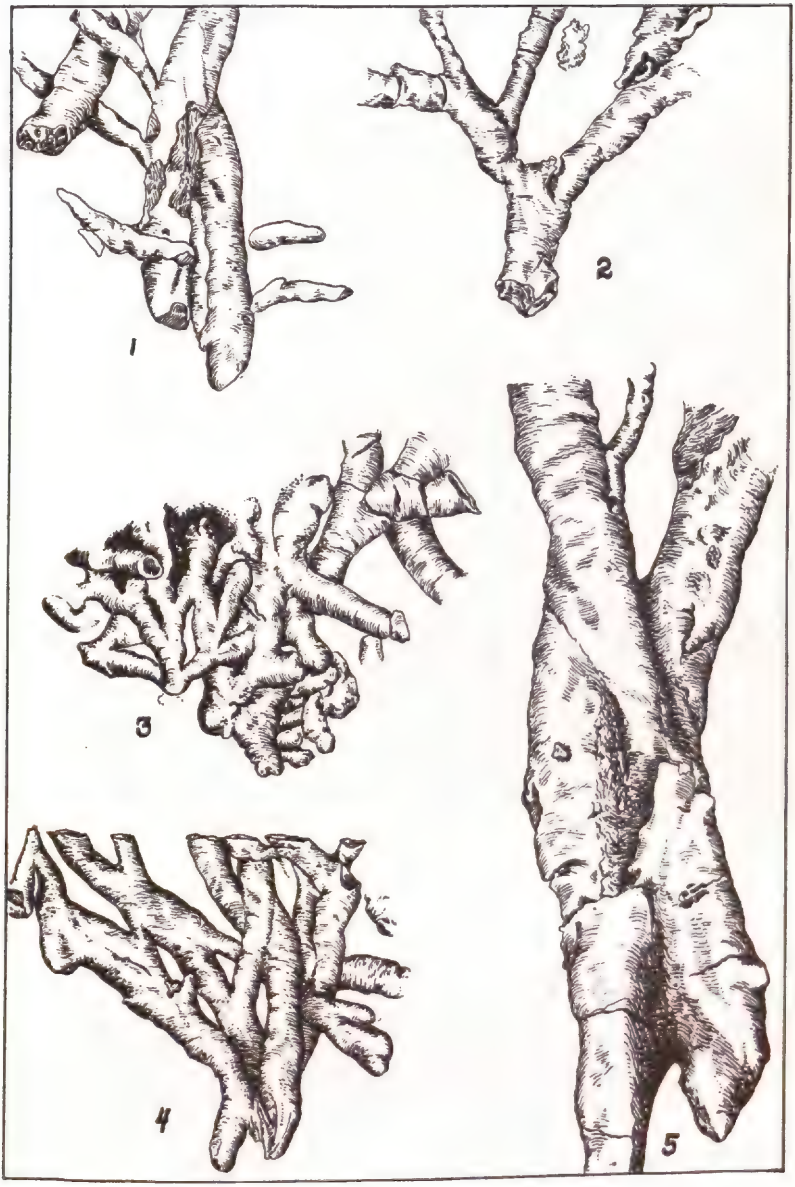
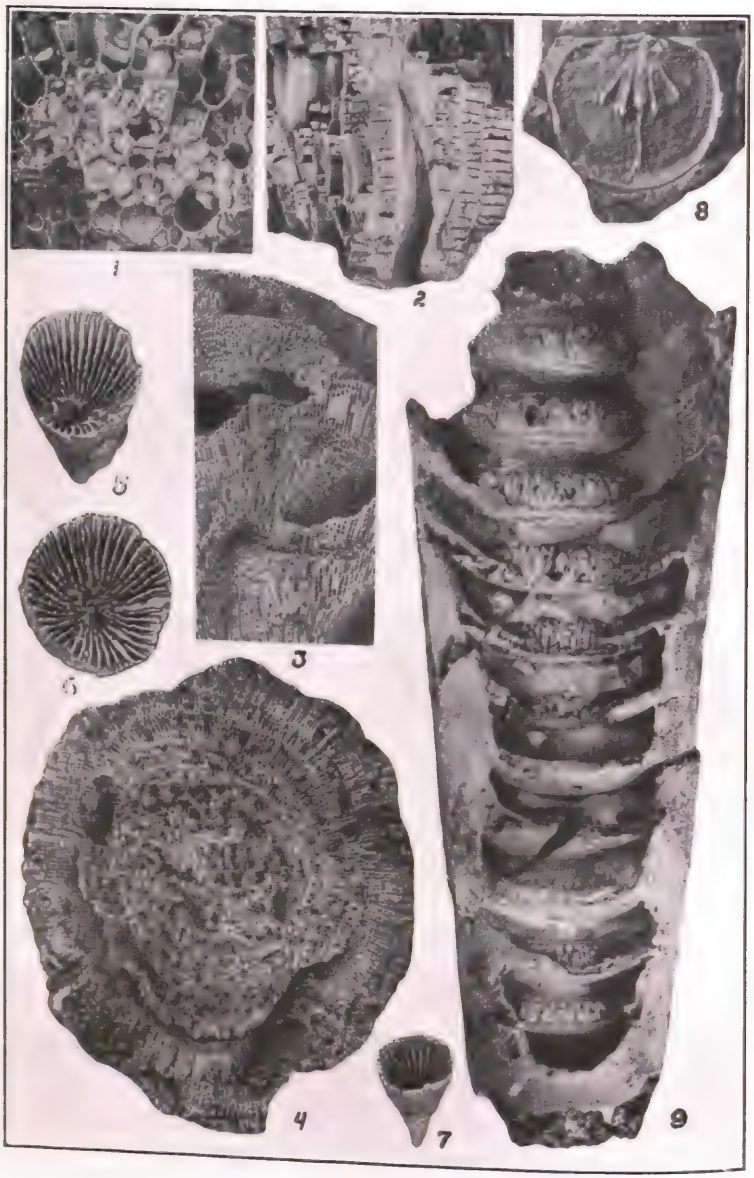


Plate I



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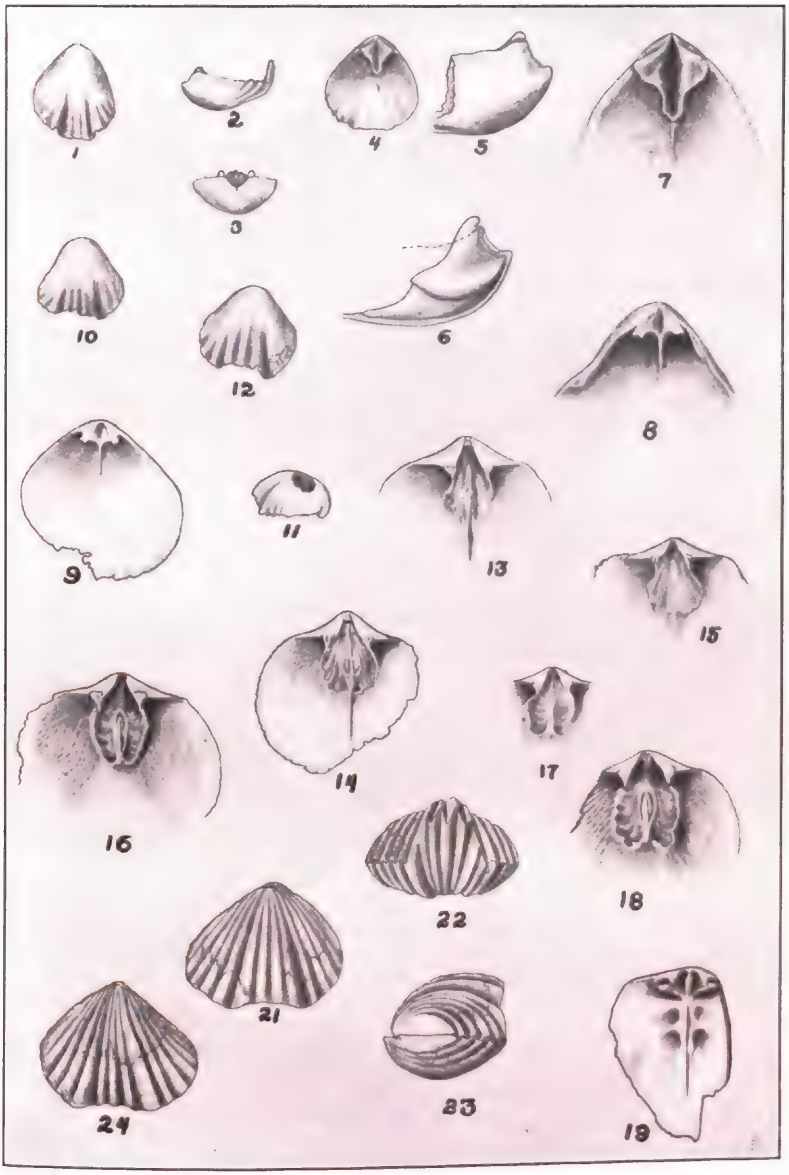

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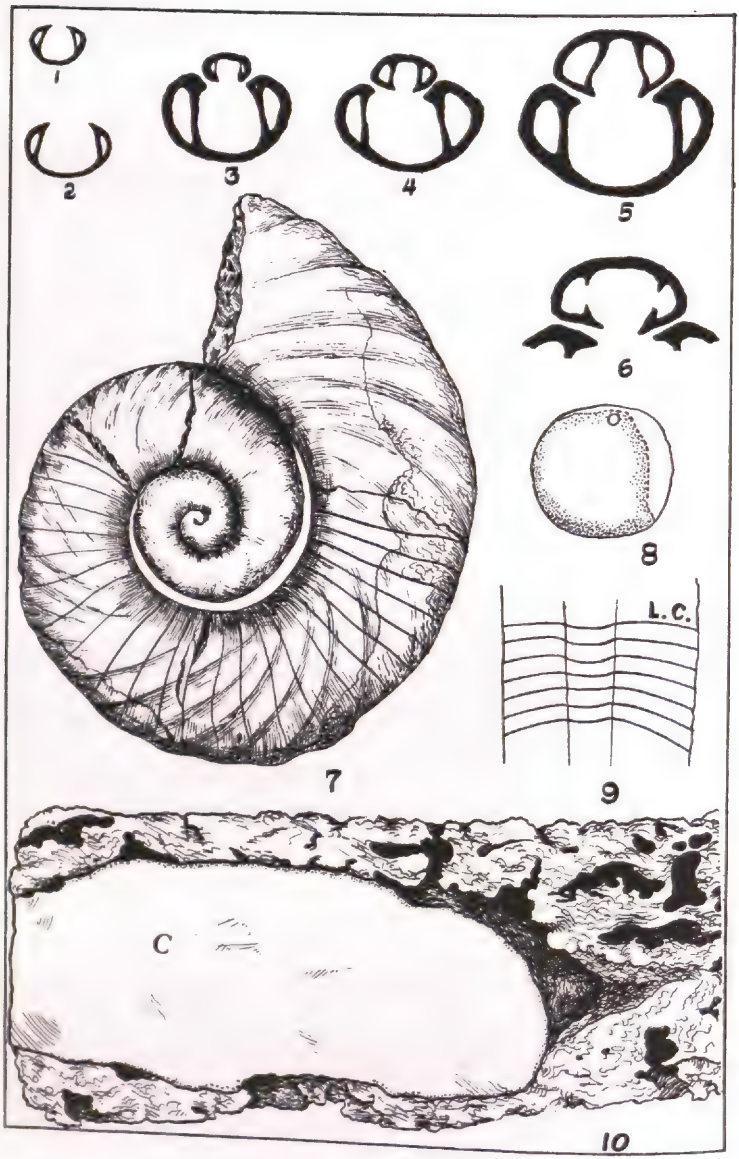

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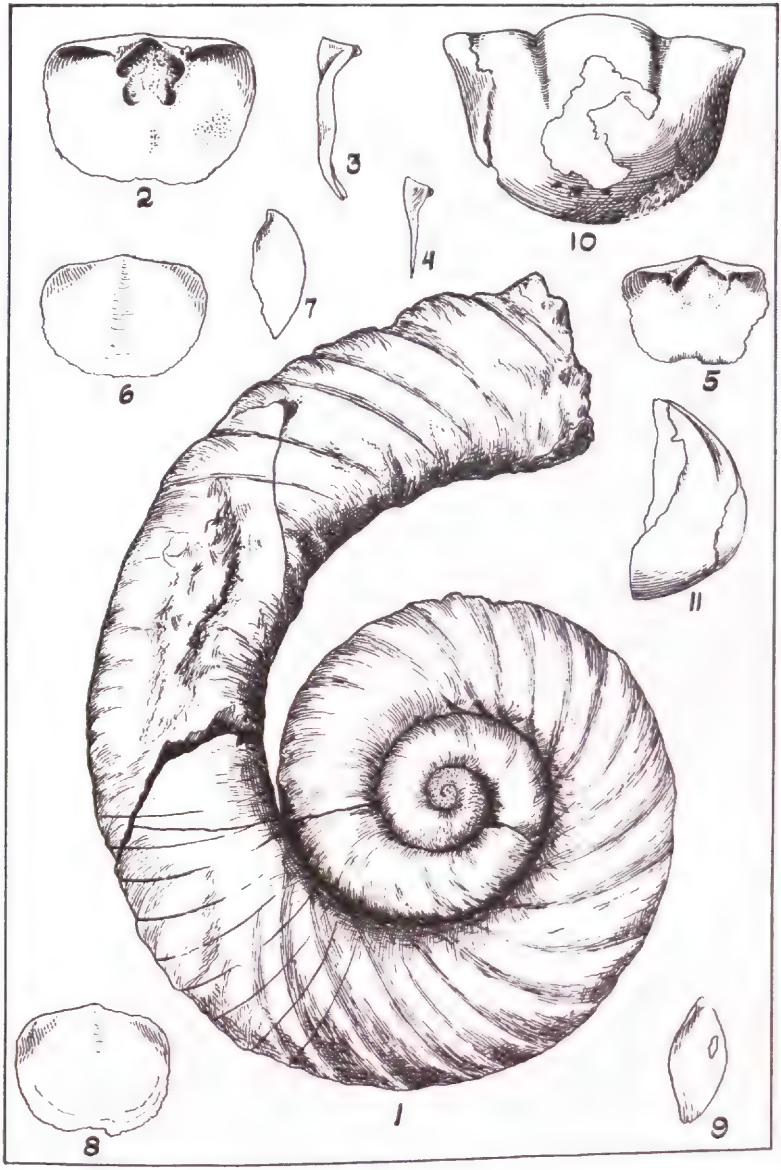

Plate V

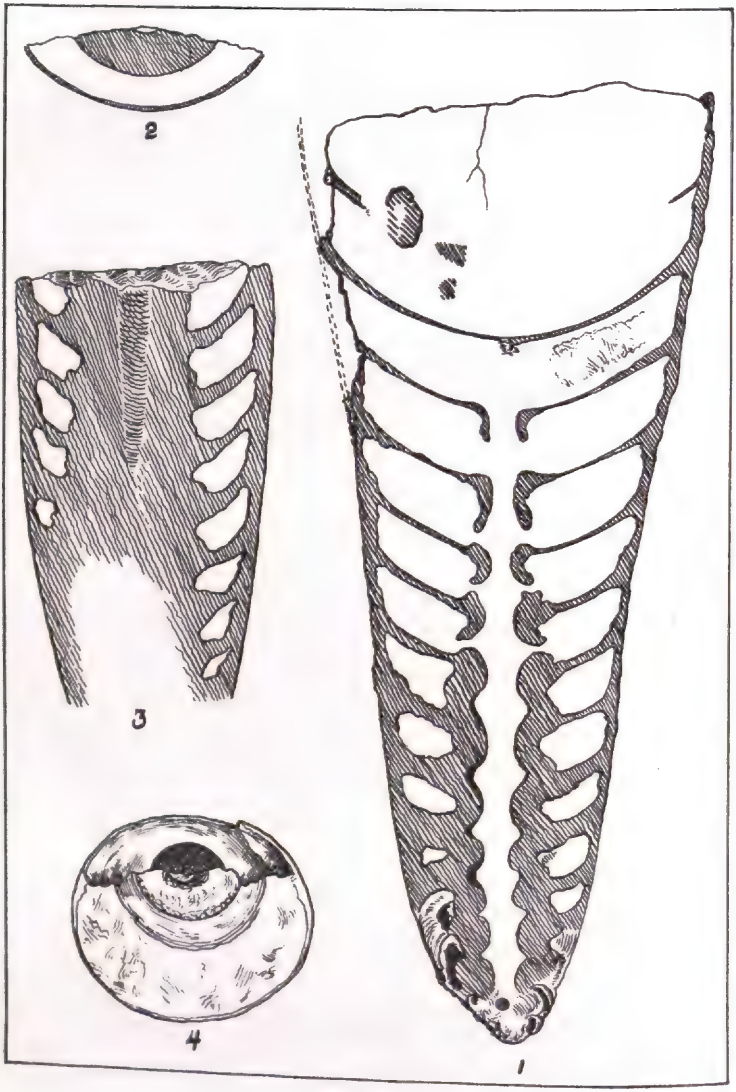

Plate VI

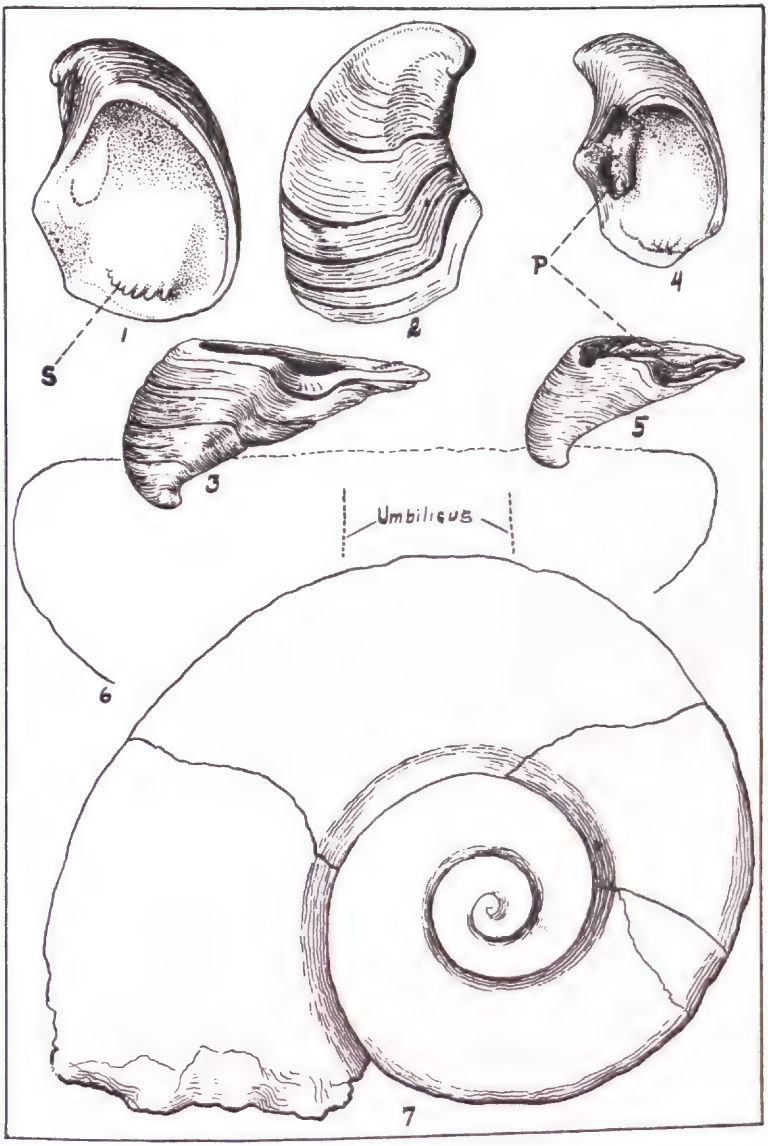

Plate VII

Plate VIII

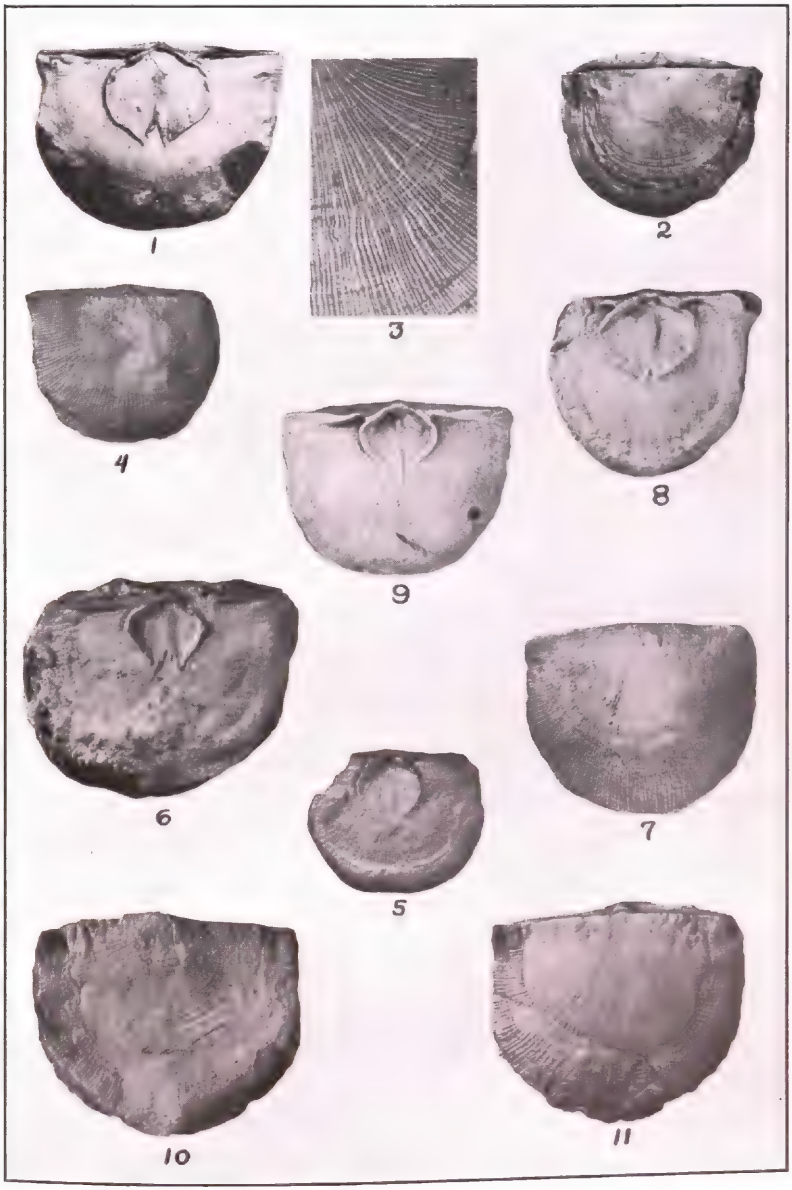

Plate IX

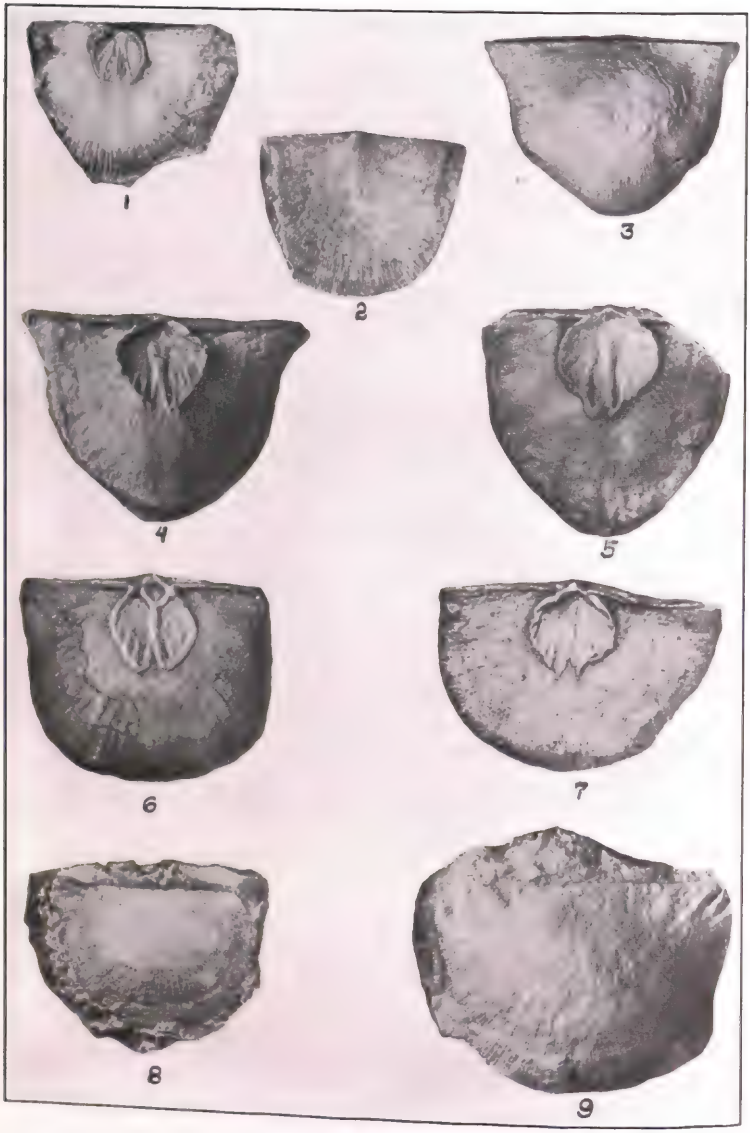

Plate X

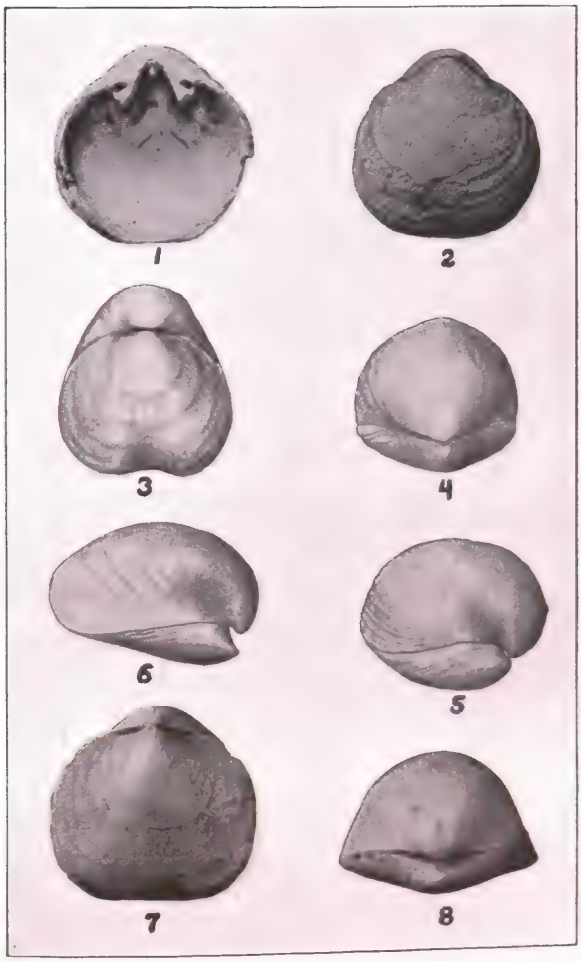

Plate XI

Orthis (*Dalmanella*) *subaequata* Winchell and Schuchert, Geol. Minn. vol. 3, pt. 1, p. 446, pl. 33, figs. 30-36. 1893.

(For other references see Bassler, Bull. 92, U. S. Nat. Mus.)

Description.—Since the species has been described in some detail by Winchell and Schuchert, only those of its characters will be mentioned which serve to distinguish it from *P. perveta.*

Pedicle valve rather uniformly convex; flattened rather than sharply depressed posterolaterally. In most specimens the sinus is indistinguishable within 10 mm. of the beak, and is neither deep nor sharply defined. Internally, the diductor scars are bounded by a sharp, highly crenulate margin which, in this shell, is lacking from the anterior part of the scar. Scars radiately ridged and furrowed; so far as can be told there are no concentric wrinkles. Adductor scars faintly impressed on the slopes of a sharply angular septum which reaches its greatest size within the limits of the diductor scars, but continues anteriorly for 2 to 4 mm., even on thin shells.

Brachial valve uniformly convex, or with a gentle fold; mesial depression rare. Even when present it rarely reaches the middle of the valve. Septum and muscle scars less marked than in *P. perveta.*

Surface of both valves marked by radiating costae which, in the anteromesial region number 14 to 17 in the space of 5 mm. They are rounded, and separated, by fine, angular furrows. Though tubular in the mesial regions, they show few openings, and I have seen no specimens in which they are even incipiently spinose.

Occurrence.—Black River, Mississippi Valley. Lower Plattin, "Widow's Nose," and perhaps higher strata on South Beckett Hill, Ste. Genevieve Co., Mo.

PIANODEMA PERVETA (CONRAD)

PLATE III, FIGS. 16-19.

Orthis perveta Conrad, Proc. Acad. Nat. Sci. Phila., vol. 1, p. 333. 1843.

Orthis perveta Hall, Geol. Wis., vol. 1, p. 42, fig. 7. 1862.

Orthis (*Dalmanella*) *perveta* Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, pl. 5 C, fig. 12; perhaps 13-14. 1892.

Orthis (*Dalmanella*) *subaequata* var. *perveta* Winchell and Schuchert, Geol. Minn., vol. 3, pt. 1, p. 450; pl. 33, figs. 41-42. 1893.

Orthis (*Dalmanella*) *subaequata* var. *gibbosa* Winchell and Schuchert, Geol. Minn. vol. 3, pt. 1, p. 451 (part) pl. 33, figs. 43-45. 1893.

(For other references see Bassler, Bull. 92, U. S. Nat. Mus.)

Description.—Shell small, with greatest width anterior to hinge line; extremities angular or rounded. Dimensions of three specimens from the Decorah shale, the third gerontic: length of brachial valve 13.5, 16.7 and 16.5 mm.; length of pedicle valve 15.6, 17.5 and 17 mm.; width 19, 22.3 and 19.7 mm.; thickness 9.8, 14 and 14 mm.; height of cardinal area 3.2, 3.3 and 5 mm.

Pedicle valve convex umbonally, becoming flattened near the extremities; 5 to 6 mm. anterior to the beak appears a shallow, broad sinus, whose boundaries are marked by sharp depressions, but whose central portion is convex. Extremities typically angular but rounded in gerontic specimens. Cardinal area arched; deltidium rudimentary. Teeth heavy, supported by short, heavy dental plates. Internally the diductor scars are deeply impressed and bounded by a heavy angular margin which normally continues unbroken around the anterior margin of the scar. Radiating ridges and depressions, such as characterize *P. subaequata*, are faint or absent; their place is taken by concentric wrinkles which are strong in thick shells. Adductor scars are sharply impressed on either side of a broad median ridge which rarely extends beyond the muscular region. Genital ridges and pustules heavy.

Brachial valve convex umbonally, recurved on the extremities with a broad mesial depression which in some old specimens is replaced anteriorly by a low, broad fold. Internally, the diductor scars are situated on a sharp septum, while the

four adductor scars are shallow. Cardinal process and crural plates heavy.

Surface of both valves marked by rounded costae which increase by bifurcation and are separated by angular furrows. In the mesial region, particularly of the pedicle valve, these costae are tubulose and even subspinose. In this region they number 9 to 12 in the space of 5 mm.

Remarks.—Heretofore the diagnostic character of this form has been only its coarse costae. Specimens from the Plattin, however, show marked and constant internal difference from *P. subaequata*, which certainly entitle *perveta* to rank as a species.

Its relationships to *P. gibbosa* of the East I have not been able to determine. From the coarseness of its plications, however, it seems clear that the specimen of Winchell and Schuchert's figures is a gerontic individual of *P. perveta*.

Occurrence.—Plattin (lower?) "Widow's Nose," numbers 27 (and higher beds) South Beckett Hill, Ste. Genevieve Co., Mo.; Decorah, near Ste. Genevieve, Mo.; Decorah (?) Minneapolis, Minn.

PROTORHYNCHA? PLATTINENSIS N. SP.

PLATE III, FIGS. 21-24; PLATE IV, FIGS. 1-6.

Description.—Shell small; dimensions of three specimens (the holotype and two paratypes): length 8.8, 7.9 and 7.2 mm.; width 10.4, 10 and 7.6 mm.; thickness 6.8, 6.2 and 4.3 mm.; width of sinus 5.8, 4.6 and 4.7 mm.

Pedicle valve moderately convex umbonally, but flattened on the lateral slopes, which meet the antero-lateral margin with but slight increase in convexity. Beak prominent, sharp, incurved, with the delthyrium partly filled by the beak of the brachial valve. Mesial sinus originates 2 to 3 mm. anterior to the beak; it contains 3 to 5 plications which are either simple or, in rare cases, bifurcating. Brachial valve more convex than the pedicle; beak abruptly incurved, lateral slopes strongly convex. Umbonally there is a distinct depression,

which gives way to the fold about 3 mm. anterior to the beak. Plications of the fold generally number 4, rarely bifurcating. Surface of the valve marked by 17 to 19 strong plications.

Remarks.—This shell is referred to *Protorhyncha* with considerable doubt. It differs from the description given by Hall and Clark in having a pronounced sinus, and from *P. ridleyana* as determined by Ulrich, in having marked septal plates.

The whole status of the genus,, moreover, is uncertain. Raymond[4] and Bassler[5] show that the species which Hall and Clarke illustrated in their descriptions of *Protorhyncha* actually belongs to another genus; that the genotype probably is *P. ridleyana* of Safford, and that the only member of the genus which has been properly described is the *Catazyga uphami australis* of Foerste.[6] Even for this no illustrations of internal characters are given. In view of this general uncertainty it might be well to discard the genus—but that would require more study than has been possible in the preparation of this paper. The one remaining course has been to refer this plattin shell to *Protorhyncha*, with this expression of uncertainty.

Occurrence.—Plattin, particularly Numbers 2 and 3 of the general section in the Little Saline region. Apparently equivalent beds near Glencoe, Missouri.

CAMARELLA BELLA N. SP.

PLATE III, FIGS. 1-12.

Description.—Shell small, gibbous. Dimensions of two pedicle valves and a brachial: length 12, 12.5 and 10.6 mm.; width 11.2, 12.6 and 11.3 mm., thickness 4.7, 4.6 and 6.5 mm. These specimens are shown on figs. 1-3, 4 and 10 respectively.

Pedicle valve convex umbonally, depressed laterally, with a broad, flat-bottomed sinus anteriorly. Cardinal slopes abrupt,

4 Ann. Carn. Mus., vol. 7, p. 226. 1911.

5 Bull. 92, U. S. Nat. Mus., p. 1049. 1915.

6 Bull. Sci. Lab. Den. Univ., vol. 16, p. 31, pl. 2, figs. 19 a-b; pl. 3, figs. 14 a-c. 1910.

flattened. On the sinus are 3 or 4 rounded plications separated by deep, angular furrows; on the slopes these number 4 or 5, the outermost always being faint and incomplete. Internally the dental lamellae unite to form a deep, elongate spondylium, which is borne upon a thin septum.

Brachial valve, in adult shells, more convex than the pedicle, with low, flattened fold. Internally the heavy, angular crural bases are borne on short plates which are continuous with a long, low septum. Plications correspond to those of the opposite valve.

Remarks.—Externally the wider specimens of *C. bella* resemble some of the specimens of *C. volborthi* Billings. In that form, however, the plications are stronger than in the Missouri species, the crural plates shorter, and the crural bases rounded rather than angularly sub-bifid at their termini.

Occurrence.—Lower middle beds of the Plattin, Ste. Genevieve Co., Mo. Collected by Dr. Stuart Weller.

MACLURITES BIGSBYI HALL

Remarks.—Shells of *M. bigsbyi* are uncommon in the Plattin of Ste. Genevieve County. One, 40 mm. in diameter, was collected in the operculum bed (Number 27), in a slab containing the form *dixonensis*. Two smaller specimens were collected from Number 26.

MACLURITES BIGSBYI DIXONENSIS ULRICH

PLATE VII, FIGS. 1-7.

Maclurea bigsbyi dixonensis Ulrich, Geol. Minn., vol. 3, pt. 2, p. 1039. 1897.

Description.—Shell large, ranging to 95 mm. in diameter. General shape like that of *M. bigsbyi*. Outer margins rounded, fitting within an angle of slightly less than 90 degrees. The umbilicus takes up less than one-third the diameter of the shell—in the holotype its diameter is 22 mm.; the walls are so steep as to be nearly vertical. Characters of the operculum are shown in the figures.

Remarks.—None of the specimens referred to *M. bigsbyi dixonensis* are well preserved, but the casts show the characters of outer angle, small umbilicus, and steep wall which characterize that form. The outlines of the opercula conform to *dixonensis* rather than *bigsbyi*, and some of them are much too large to fit any of the latter shells which have been found in the Plattin.

Two or three specimens suggest Whitfield's species, *Maclurina subrotunda*, but they are not adequate for identification. By far the greatest number of Plattin specimens belong to the former type, which from its apparently scanty development in the Platteville, seems to be the southerly race of the species *bigsbyi*.

Occurrence.—Platteville, Mineral Point, Wis., and Dixon, Ill.; one specimen is available from each locality. Common in the middle and upper Plattin of Ste. Genevieve County; abundant in beds number 26 and 27 of the general section.

ACTINOCERAS GRAVICENTRUM N. SP.

PLATE II, FIG. 9; PLATE VI, FIGS. 1-4.

Actinoceras bigsbyi Clarke, Geol. Minn., vol. 3, pt. 2, p. 781, pl. 47, figs. 16-17. 1897. (Fig. 15 may represent a variety.)

Description.—Large orthoceracone, the largest specimen at hand having the following dimensions: length (incomplete), 168 mm.; minimum transverse diameter, 28 mm.; maximum 71 mm.; a paratype has a minimum transverse diameter of 24 mm., with the end of the shell not shown.

Septa strongly concave, thin near the living chamber, but thickened by secondary deposits posteriorly. Camerae from 8 to 14 mm. in length, increasing in size toward the living chamber. In the apical region they are largely filled by expansions of the siphuncular wall. This is large and heavy, constricted at the septa, and expanding and thickening strongly between them. The great thickness of the wall in the apical region makes the siphuncle appear to diminish in size anteriorly. It is markedly eccentric.

Remarks.—This, the most characteristic cephalopod of the Plattin in Ste. Genevieve County, seems to be identical with specimens from Minnesota identified as *A. bigsbyi* by Clarke. That species was figured, without name, by Bigsby in the Transactions of the Geological Society of London (2d. ser., vol. 1, pl. 25, figs. 1-2) and later named by Bronn; no description, based on the types, is available. Moreover, the figures show shells which have more moderate rates of expansion than does *A. gravicentrum*, and smaller camerae; that is, shells close to *A. tenuifilum* Hall from the Black River of New York. To that species *A. gravicentrum* also is closely related, and perhaps a large series of specimens from many localities would show it to be but a variety of the New York species. Until such a series is available it seems well to adopt the convenient, though perhaps artificial, device of calling *A. gravicentrum* a species.

Occurrence.—Platteville of Minneapolis and Rochester, Minn.; middle Plattin of Ste. Genevieve County, Mo., where numbers 25 and 26 of the general section bear abundant broken conchs of the species.

EURYSTOMITES ROBERTSONI (HALL)

PLATE IV, FIGS. 7-9; PLATE V, FIG. 1.

Lituites robertsoni Hall, Geol. Surv. Wis., Rep. Prog., p. 38. 1861.

Lituites robertsoni Whitfield, Mem. Am. Mus. Nat. Hist., vol. 1, pt. 2, p. 64, pl. 10, figs. 4-6. 1895.

Eurystomites robertsoni Miller, N. A. Geol. Pal., 2d. App. p. 773. 1897.

Description.—Conch discoid, loosely nautiliconid, moderately depressed, the venter being slightly flattened and the lateral zones but moderately curved. Whorls three or four. Siphuncle circular in section, slightly nummuloidal, subventran. Senile whirl free. Character of aperture unknown. Apertural diameter of larger plesiotype about 26 mm.; diameter at base of living chamber 22 mm. Length of living

chamber, measured along venter, 117 mm. Rate of expansion in the smaller plesiotype somewhat less than is indicated by these measurements of the larger.

Septa moderately concave. Sutures straight in nepionic stages; in the ephebic they develop dorsal saddles with low auxiliary lobes. In the outer whorl the camerae average 5 mm. in maximum depth.

Surface marked by undulating folds which arise on the upper lateral zones and curve backward and downward, extending as low, indistinct ridges onto the venter. In some specimens (large cotype; larger plesiotype), the ridges from opposite sides meet on the venter; in others (small plesiotype), the center of the venter is smooth in ephebic stages.

Remarks.—Hall's cotypes, preserved in the American Museum of Natural History, correspond closely to the smaller of the two specimens from Ste. Genevieve County. None of these possess more than a fraction of the living chamber, whose cast is almost entire in the larger Missouri specimen. Apparent differences in rate of expansion may be caused by weathering.

Occurrence.—"Buff limestone" of the Platteville at Beloit, Wis., and Rockford, Ill.; upper Plattin, Gabouri Creek, and number 26 of the Plattin at South Beckett Hill, Ste. Genevieve County, Mo.

EXPLANATION OF PLATES

PLATE I

FIGURE		PAGE
1	*Buthotrephis regularis* n. sp. Major part of the holotpe, x 1. (W. M. 25951)	125
2— 3	*Buthotrephis brachiatus* n. sp.	126
2	Portion of a paratype, x 1. (W. M. 25953)	
4	*Buthotrephis* sp.	126
3	Central portion of the holotype, x 5. (W. M. 25949)	
	Part of a well-preserved specimen, x .75. (W. M. 25952)	
5	*Paleophycus tubulare* Hall	126
	Two crossed "stems," referred to this species. x .7. (W. M. 25950)	

PLATE II

FIGURE		PAGE
1— 2	*Columnaria halli* Nicholson	128
1	Part of a specimen showing the variable size of the corallites and the strong septal ridges. (W. M. 25945)	
2	Another specimen, showing the spacing of the tabulae. (W. M. 25946)	
3— 4	*Monotrypa magna* Ulrich	129
3	Central portion of the under side of a large zoarium, showing the typical manner of growth. (W. M. 25509)	
4	Portion of another specimen, showing the diaphragms.	
5— 7	*Streptelasma corniculum medium* n. var.	128
5	Calyx of a large specimen. (W. M. 25932)	
6	A smaller specimen. (U. C. M. 812)	
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8	*Rafinesquina minnesotensis* Winchell	130
	Interior of a brachial valve, with characteristic markings. (W. M. 25512)	
9	*Actinoceras gravicentrum* n. sp.	138
	Holotype, showing the very large siphuncle and highly convex septa. (W. M. 25963)	

PLATE III

FIGURE		PAGE
1—12	*Camarella bella* n. sp.	136
1— 4	External, lateral and internal views of a pedicle valve, the holotype, x 1. (W. M. 33409)	
5	Exterior lateral view of the umbo of the allotype. x 2. (W. M. 33410)	
6	Same, with part of the shell removed. x 2.	
7	Internal view of the umbonal region of a paratype. x 2. (W. M. 33411)	
8	Internal view of a brachial valve. x 2. (W. M. 33412)	
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12	A second, larger brachial valve. x 1. (W. M. 33412)	
13—15	*Pianodema subaequata* (Conrad)	132
13	Umbonal region of a pedicle valve having an unusually high septum. x 1.5. (W. M. 33418)	
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15 Umbonal region of a pedicle valve in which the septum is weak. x 1. (W. M. 33419)

16—19 *Pianodema perveta* (Conrad) ---------- 133

16 Internal view of a pedicle valve, placed beside a figure of *P. subaequata* (Fig. 14), to show the marked differences between their muscular areas. x 1.5. (W. M. 33416)

17 Muscle scars of another pedicle valve. x 1.5. (W. M. 33417)

18 Umbonal region of a third specimen, with very heavy scars. x 1.5. (W. M. 33425)

19 Internal view of a brachial valve with exceptionally clear markings. x 1.5. (W. M. 33415)

21—24 *Protorhyncha? plattinensis* n. sp. ---------- 135

Brachial, anterior, lateral and pedicle views of the holotype. x 2. (W. M. 25638)

Plate IV

FIGURE PAGE

1— 6 *Protorhyncha ? plattinensis* n. sp. ---------- 135

A composite series of sections illustrating the internal character of this form. x 5. (W. M. 25637)

7— 9 *Eurystomites robertsoni* (Hall) ---------- 139

7 A specimen preserving part of the living chamber. (W. M. 25971)

8 A tranverse section showing the siphuncle.

9 Drawing of the sutures on the inner side of the outer whorl of the same specimen. L. C., living chamber.

10 Surface slab from the Streptelasma bed; outer part silicified and porous, while the core (C) remains crystalline limestone. Described on ---------- 92 (W. M. 25935)

Plate V

FIGURE PAGE

1 *Eurystomites robertsoni* (Hall) ---------- 139

A specimen preserving most of the living chamber. The septa are drawn in from the opposite side of the specimen. (W. M. 25970)

2— 9 *Dinorthis deflecta gibbosa* n. var. ---------- 131

2— 3 Internal and lateral views of a large pedicle valve, the holotype. It shows marked convexity at the extremities. (W. M. 33402)

FIGURE PAGE

4— 5 Lateral and internal views of a smaller valve. (W. M. 33406)

6— 7 External and lateral views of a brachial valve. (W. M. 33403)

8— 9 External and lateral views of another brachial valve, with sharply reflected extremities. (W. M. 33407)

10 *Bumastus* sp. Mentioned in section particularly ---------- 88
The largest specimen found. (W. M. 33408)

PLATE VI

1— 4 *Actinoceras gravicentrum* n. sp. ---------- 138

1 Natural longitudinal section, nearly horizontal. The allotype. (W. M. 25968)

2— 3 Longitudinal and transverse sections of another specimen. (W. M. 25969)

4 Transverse section of another specimen, showing fusion of the siphuncle and shell wall. (W. M. 25964)

PLATE VII

1— 7 *Maclurites bigsbyi dixonensis* Ulrich ---------- 137

1— 3 Three views of a large operculum attributed to this form. Dotted line indicated the position of the muscular process. S, scars. (W. M. 33422)

4— 5 Two views of another operculum which shows both process and scars. P, process. (W. M. 33423)

6 Outline of a large natural cast, to show the outer angle of the whorls and size of umbilicus. (W. M. 25936)

7 Ventral side of the same specimen.

FORMS OF STROPHOMENA FROM BLACK RIVER AND RICHMOND FORMATIONS[1]

By CARROLL LANE FENTON

I. INTRODUCTION

In collections of fossils from the Plattin and Decorah formations of Ste. Genevieve County, Missouri, there were, in addition to the forms listed and described in previous papers, [2, 3] numerous specimens belonging to the brachiopod genus *Strophomena*. It soon was found that this material could be described only after comparisons had been made with species of the same genus from the Platteville and Decorah formations of the upper Mississippi valley, from Black River rocks of New York and Canada, and even from the Richmond strata of the Ohio valley. To include such a heterogeneous collection in a paper ostensibly dealing with the larger fossils of the Plattin formation clearly was impossible, and the material therefore was organized under a new title.

As the paper stands, therefore, it presents a description of "species," some of which are new, prefaced by a discussion of the taxonomy of Black River members of the genus *Strophomena*. That the conclusions reached in this discussion do not of necessity extend to all members of the genus is amply indicated by the fact that I have carefully examined but two species from that most prolific of all *Strophomena*-bearing horizons, the Richmond.

II. TAXONOMY

In descriptions of species of *Strophomena*, various characters have been stressed by different authors: shape of shell,

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1 Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 4.

2 Proc. Ia. Acad. Sci., vol. 29, pp. 67-84. 1923.

3 This journal, Vol. 11, pp. 86-96, and this issue pp. 125-143.

wrinkling of extremities, presence or absence of septum, flatness of umbo, etc. In this study, however, it soon became plain that some of these characters, no matter how significant they might be among Richmondian species, did not afford data for the determination of Black River forms.

An attempt therefore was made to evaluate the various characters already stressed by earlier authors, to discover others which might be significant, and to formulate working principles, or conclusions, as an aid to description. These last may be summed up as follows:

1. Shape of shell, among closely related forms, has little significance, particularly in Black River species; nor is its evidence apt to be conclusive even where significant. It always should be supplemented by other, and preferably internal characters.

2. Production and wrinkling of cardinal extremities are highly variable characters, apparently dependent upon environment and age (vide *S. musculosa*).

3. Characters of costae are of uncertain value, but deserve consideration.

4. Thickness of shell is significant only when it is accompanied by other characters, particularly those which indicate racial senescence. Mere thickness or thinness probably is traceable to environment.

5. The muscle scars and septa of the pedicle valve offer characters of major taxonomic value among the Black River forms of *Strophomena*, and probably in others. Shape of scars, width and thickness of ridges, margins and septa,—all display characters of considerable permanence. Variations in thickness of shell seem not to affect seriously the essential characters of either scars or septa.

The last conclusion was accepted with some reluctance. It is true that in his large paper on *Strophomena*,[4] Foerste indicated the importance of the pedicle muscle scars in several

4 Bull. Sci. Lab. Denison Univ., vol. 17, pp. 17-173, pls. 1-18. 1912.

forms, and they have been illustrated by many authors. But to assign these scars diagnostic value, while characters of shape, proportion and surface are regarded as secondary or even negligible, seemed at first a radical step. Also, it increased the difficulty of identifying specimens of *Strophomena;* for though good interiors of pedicle valves are not rare, they are less common than exteriors. Yet the loss is more apparent than real. On the basis of external characters, several forms which are different seem to be identical, and some which are identical seem different; and if internal features serve to correct such errors, one need not regret a few exteriors or molds that must go unnamed.

A few comparisons have been made to determine the relationships of the various forms described, but aside from the comments made in connection with *Strophomena vetusta* and *S. neglecta,* nothing can be said about evolution. Nor have I made any attempt to determine the proper taxonomic rank of the various forms described. In the first place, this cannot be done without a comprehensive and detailed study of the entire genus; in the second, it requires a certainty on the questions of taxonomic ranking which I do not feel. I have chosen, therefore, to take the course which best indicates this uncertainty and which offers the fewest obstacles to future revision, and have called each new form a species. In this sense the word is merely a convenient designation, without definite significance, and the binomials indicate no close relationships which some future student might find to be non-existent.

III. STATUS OF STROPHOMENA INCURVATA (SHEPARD) AND S. FILITEXTA HALL

Prominent among the identifications of Black River Strophomenas stand the species *S. incurvata* (Shepard) and *S. filitexta* Hall. Bassler [5] has given bibliographies of both,

[5] U. S. Nat. Mus., Bull 92, vol. 2, p. 129. 1915.

and has expressed the opinion that *filitexta* is a synonym of *incurvata.*

Examination of literature, however, showed a wide variation in interpretation of the latter species and the reason for it: Shepard's description of his fossil is exceedingly indefinite, and his figures are unrecognizable. The specimens are said to come from Green Bay Wisconsin, a region where Ordovician rocks can occur only in drift. Attempts to secure such specimens have been futile, but from the location it may be concluded that the originals were not from rocks originally forming part of the Platteville formation. Nor does it seem possible, without specimens or recognizable figures, to say that the missing types were identical with forms from the East. The one satisfactory course is to abandon the species.

There remains *Strophomena filitexta* Hall, described from specimens found at Middleville, N. Y.[7] Although the types were supposed to be in the collections of the American Museum of Natural History[8], Dr. Reeds writes me that they are lost, and the museum has no other good specimens from the type locality. Nor are specimens to be found in the New York State Museum and the U. S. National Museum, where Doctors Ruedemann, Bassler and Ulrich have searched for them.

In considering the status of *S. filitexta,* little weight can be given to the figures in plates 9 and 9A of Volume VIII of the Paleontology of New York. They represent a miscellaneous array of specimens, none of which are from New York, and at least one (Fig. 12, Plate 9A), from the Richmondian of the Ohio valley. Two (Figs. 3 and 5, Plate 9), appear to be identical with *S. plattinensis* of this paper. Nor does it seem possible to accept the descriptions of other authors than Hall, since there is no assurance that these descriptions conform to the missing types.

From the examination these facts emerge: (1) *Stropho-*

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6 Am. Journ. Sci., vol. 34, p. 144, figs. 1-2. 1838.
7 Pal. N. Y., vol. 1, p. 111, pl. 31B, figs. 3 a-f. 1847.
8 Am. Mus. Nat. Hist., Bull 11, pp. 38-39. 1898.

mena filitexta Hall cannot be considered a synonym of *S. incurvata* (Shepard), since the latter is not recognizable. (2) The *Strophomena filitexta* of Hall and Clarke is non-existent, having been applied to a varied array of specimens, of which none appear to be identical with the types. (3) *Strophomena filitexta* Hall is not so described as to be indentifiable without reference to specimens, which at present are lacking.

So far as this paper is concerned, there is no need to either accept or reject Hall's species. On the other hand, there seem no grounds for further use of the name unless it is applied to specimens from the type locality and (if possible) stratum, with adequate description and illustration. Certainly any student of Strophomenas of the East who cannot secure such specimens will be justified in disposing of Hall's species as unrecognizable.

IV. DESCRIPTIONS

STROPHOMENA AUBURNENSIS N. SP.

PLATE IX, FIGS. 1-3.

Description.—Shell of medium to large size; thin. Dimensions of one complete specimen and one pedicle valve: length 23.2 and 27.4 mm.; width 28.5 and 37 mm.; thickness 5.3 mm. and ——. One exceptionally convex brachial valve shows a thickness of 8.3 and a width of 34.3 mm.

Pedicle valve slightly convex umbonally. Cardinal area broad and acutely retrorse; deltidium strongly convex, about twice as wide as high. Teeth prominent and heavy, borne on the raised border of the muscular area. The latter is large and elevated, being divided into two lobes by a broad, rounded septum which begins 1 to 1.5 mm. anterior to the beak. Each lobe terminates anteriorly in a point. The shallow, linear adductor scars are on the septum; diductor scars striate, with sharp, elevated margins. The intramarginal thickening is crossed by numerous straight vascular sinuses. Entire inner surface finely tuberculate.

Brachial valve flattened umbonally, with slight median depression. Cardinal area narrow; beak small and pointed.

Cardinal extremities slightly crenulate and strongly deflected.

Surface of both valves marked by rounded, radiating costae which increase by implantation. Alternation distinguishable near the beaks, where every fifth to eighth costa is markedly larger than the rest. The concentric wrinkles are closely spaced and heavy; growth lamellae numerous and prominent.

Remarks.—This form is characterized by its thin shell, heavy lamellae and wrinkles, and by its symmetrical, sharply defined muscle scars in the pedicle valve. In no other *Strophomena* studied are the adductor scars so shapely, and so consistently terminated by high points; of the group described in this paper *S. auburnensis* is the most readily identifiable.

Occurrence.—Auburn chert, Lincoln County, Mo. Collected by Dr. Stuart Weller.

STROPHOMENA PLATTINENSIS N. SP.

PLATE X, FIGS. 7-9.

Strophomena filitexta Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, pl. 9, fig. 3; perhaps fig. 5. 1892.

Description.—Shell large; cardinal extremities angular and deflected. Dimensions of two pedicle valves: length 27 and 26.6 mm.; width 41 and 37.2 mm.; thickness —— and 1.5 mm. Dimensions of two brachial valves: length 26.1 and 19 mm.; width 36 and 28.5 mm.; thickness 4.5 and 3.4 mm.

Pedicle valve convex umbonally, with beak rather prominent. Cardinal area narrow; deltidium prominent. Teeth not known. Muscular area large, strongly striate, containing faint adductor scars, on either side of which are the broad, elevated scars of the diductors. Genital markings not shown. Near the margins of the shell runs a broad, low thickening crossed by straight vascular sinuses.

Brachial valve slightly concave umbonally but elevated at the beak; moderately convex laterally and anteriorly. A broad, shallow mesial depression shows in some specimens. Cardinal area unknown. Internal characters shown by fig. 7 of plate 10.

Surface marked by fine, rounded, radiating costae which increase by implantation; they are crossed by closely spaced, rounded, concentric wrinkles which give the costae a nodose appearance. Growth lamellae prominent on the pedicle valve. Cardinal extremities more or less wrinkled in both valves, particularly the brachial.

Remarks.—This is one of the several species of *Strophomena* that have been referred to *S. incurvata*. There is little doubt that it is identical with the Mineral Point specimens of *S. filitexta* figured by Hall and Clarke.

Occurrence.—Platteville, Mineral Point, Wis.; Plattin of Ste. Genevieve County, Mo., becoming common in number 12 of the general section on South Beckett Hill, and continuing to the top. It is rare or lacking in the lower ten members.

STROPHOMENA WINCHELLI HALL AND CLARKE

PLATE IX, FIG. 8.

Streptorhynchus (*Strophonella?*) *deltoidea* Hall, 2d. Ann. Rep. N. Y. State Geol., pl. 39, figs. 10, 12-14. 1883. (Not fig. 11,—*S. nutans.*)

Strophomena winchelli Hall and Clarke, Pal. N. Y., vol. 8, p. 344, pl. 9, figs. 10, 12-14; pl. 20, fig. 26. 1892.

Strophomena winchelli Winchell and Schuchert, Geol. Minn., vol. 3, pt. 1, p. 394, pl. 31, fig. 11. 1893.

Description.—Shell of medium size, wider than long, with hinge-line produced. Dimensions of two Plattin specimens: length 23.6 and 21.5 mm.; width 31.4 and 24.6 mm.; convexity or thickness, 11 and 10.5 mm. In the second specimen the extremities are but slightly produced.

Pedicle valve convex umbonally, concave anteriorly, and reflected near the margins. Cardinal area moderately high and flat; delthyrium wide and but partly closed by the deltidium. Teeth low and strong. Diductor scars wide, flabelliform, sharply elevated. Adductor scars narrow, situated on a broad, rounded elevation that is larger in specimens from Missouri than in those from Wisconsin. Near the margins of

the valve a heavy ridge, crossed by vascular canals, appears and at the extremities fuses with the elevated posterior margin.

Brachial valve flat umbonally, very convex in the mesial region, and less so toward the margins. Two specimens show slight wrinkling near the cardino-lateral margins. Cardinal process consists of two short and slender apophyses which are united basally with the hinge plates. The latter are widely divergent, extending in broad curves subparallel to the hinge-line. Diductor scars narrow, situated on a narrow median ridge; adductors broad, flabelliform, with their margins slightly elevated.

Surface of both valves covered by fine, rounded costae which alternate regularly, though not conspicuously, in size. They are crossed by fine concentric wrinkles which are less marked than those of *S. plattinensis*. Growth lamellae not prominent.

Occurrence.—Platteville of Clifton and Janesville, Wis.; Plattin of Ste. Genevieve County, Mo. Winchell and Schuchert mention specimens from the Galena at Oshkosh, Wis.

STROPHOMENA DIGNATA N. SP.

PLATE X, FIGS. 3-5.

Description.—Shell medium to large. Dimensions of the allotype: length of pedicle valve, 25.7 mm.; length of brachial valve, 24.9 mm.; width 36.2 mm.; thickness 9.2 mm.; height of cardinal area 2.6 mm.

Pedicle valve convex umbonally, strongly concave medially, and reversed on the extremities. These are produced and moderately crenulate. Anterior margin nasute. Cardinal area flat; delthyrium wide, deltidium highly convex. Intramarginal ridge low and rounded, and crossed by fine vascular canals. The muscular area is elongate flabelliform, with high, sharp boundaries and sharp, radiating ridges on the diductor scars. Adductor scars linear, situated on a low elevation which expands posteriorly but fails to reach the umbonal

region. Teeth strong and high; genital area pustulose.

Brachial valve flattened umbonally, strongly convex medially, reversed on the moderately wrinkled extremities. Internal characters not known.

Surface marked by irregularly alternating costae, from 3 to 5 fine ones to each coarse. The concentric wrinkles are fainter than in *S. musculosa.*

Remarks.—*Strophomena dignata* is closely related to *S. musculosa,* and it is possible that both are regional variations of the same species. On the other hand, a number of variations of *dignata* within the Ste. Genevieve area argue against this.

Occurrence.—Decorah formation, two and a half miles west of Ste. Genevieve, Mo. Collected by Dr. Stuart Weller.

STROPHOMENA EXIGUA N. SP.

PLATE X, FIG. 6.

Description.—Of this form but two pedicle interiors are known. Their measurements are: length 29.7 and 26.1 mm.; width 36.2 and 32.3 mm. The cardinal extremities are slightly produced, while irregular curvature of the anterior and lateral margins gives the shell a rectangular appearance. Cardinal area high; deltidium strongly convex; teeth heavy.

The diagnostic feature of *S. exigua* is a Y-like ridge formed by the septum bearing the adductor scars and two ridges which extend from it to the plates supporting the teeth. A slightly similar structure is seen in *S. plattinensis,* where both ridges and septum are very indistinct, and the former incomplete; and in one of Hall and Clarke's figures of *"S. filitexta."* (Pal. N. Y., vol. 8, pt. 1, pl. 9, fig. 5.) Dr. John H. Bradley, Jr., tells me that a similar structure is found on one of the Kimmswick Strophomenids.

Occurrence.—Rare in the upper part of the Plattin, South Beckett Hill, Ste. Genevieve Co., Mo. The types are from number 41 of the general section.

STROPHOMENA MUSCULOSA N. SP.

PLATE VIII, FIGS. 1-7.

Description.—Shell large, wider than long. Dimensions of the allotype and two paratypes: length of pedicle valve 28.2, 22 and 16 mm.; length of brachial valve 27.4, 21.5 and 15.9 mm.; width 39, 36 and 22.3 mm.; thickness 12.7, 8 and 6.5 mm.; height of cardinal area 3.6, 4.1 and 1.8 mm.

Pedicle valve convex umbonally, strongly concave medially, with cardinal extremities reversed. In old specimens they are slightly produced. Cardinal area flat, high, bearing a wide delthyrium whose deltidium fails by 1 mm. or more to close its opening. Cardinal area weakly striate, the striae being indistinguishable in some specimens. Extremities smooth in young individuals, becoming progressively crenulate as the shell enlarges and thickens. Diductor scars broadly flabelliform, with heavy, elevated margins and strong, radiating ridges separated by deep grooves. Adductor scars borne on a low, rounded elevation which in some specimens extends beyond the muscular area. Genital region sharply pustulose. Intra-marginal ridge low and broad. Teeth heavy and prominent.

Brachial valve moderately convex in young shells, becoming highly so in old ones; its curvature is reversed at the extremities. Like those of the pedicle valve, these are progressively wrinkled. Diductor scars narrow, elevated; adductor scars broad, ridged, and without definite margins. Cardinal process bifid and heavy; hinge plates wide, enclosing deep sockets.

Surface marked by radiating costae which increase by implantation. They show irregular and inconspicuous alternation, and are crossed by concentric wrinkles, as well as growth lamellae.

Remarks.—This probably is the shell from Fountain, Minn., which Winchell and Schuchert identify as *Strophomena billingsi*. That name, however, they apply particularly to *S. recta* of Billings, reproducing his original figure. This shows

a depressedly biconvex shell with very coarse costae. None of the Fountain specimens are biconvex, and even the coarser of their striae number 15 to 20 in the space of 5 mm. There seems no reason, therefore, for concluding that they are equivalent to *S. recta* Billings.

The closest relationships of *S. musculosa* seem to be with *S. dignata* of the Decorah of Missouri, and *S. neglecta* of the Richmond. Close similarities appear in the markings of the surface, in the shape and thickness of shell, and in the shape of the muscle scars in the pedicle valve. The relationship is discussed under the heading of *S. neglecta*.

Occurrence.—Decorah formation, Fountain, Minn.

STROPHOMENA SP.

PLATE IX, FIG. 7.

Remarks.—In the Decorah material collected by Dr. Weller are specimens of a rather large *Strophomena* whose brachial valve is highly convex, whose extremities are neither produced nor wrinkled, and whose costae are crossed by weak concentric wrinkles. In general type the shell is distinct; but since there are no interiors which may be reliably associated with the brachial exteriors, description as a species is unjustifiable.

STROPHOMENA INCONSUETA N. SP.

PLATE X, FIGS. 1-2.

Description.—Of this form only pedicle valves are known. Dimensions of the two types: length 22.4 and 23.1 mm.; width 27 and 28.3 mm.; thickness (concavity) 2 and 2.3 mm.

Valve subquadrate in outline, with extremities sharp but not produced. Muscular area broad, flabelliform, not much elevated along its margins, and depressed posteriorly. Diductor scars broad, faintly ridged, and indefinitely terminated anteriorly, since the bounding ridges give rise to others that extend beyond the scars. Adductor scars on a low, indistinct ridge.

Surface marked by rounded costae, every fourth (rarely, third) of which is heavier than the others. Commonly there is secondary alternation, the middle of the three lesser costae being thicker than the others.

Remarks.—The shape, surface characters, and muscle scars of this form seem to warrant its description; though rare it should prove readily identifiable.

Occurrence.—Upper part of the Plattin, South Beckett Hill, Ste. Genevieve Co., Mo.

STROPHOMENA DELICATULA N. SP.

PLATE IX, FIGS. 4-6.

Description.—Shell of medium size. Dimensions of the holotype and two other specimens: length of pedicle valve 21.5, 23 and 23 mm.; length of brachial valve 19.6 and 21.8 mm.; width 25.8, 27.8 and 31.5 mm.; thickness 4.5, 6 and 7.2 mm.; height of cardinal area 2.7, 2.9 and 3.2 mm.

Pedicle valve convex umbonally, flattened medially and postero-laterally and concave antero-centrally. Extremities with curvature reversed; in some specimens they are wrinkled, but in others smooth. Cardinal area without vertical striae. Brachial valve moderately convex, flattened umbonally, with the extremities reversed and commonly wrinkled. Surface marked by irregularly alternating costae which, on the anterior margin, number 17 to 25 in the space of 5 mm. The alterations are more marked on the pedicle valve than the brachial, there being 3 to 5 fine costae for every coarse one. Concentric wrinkles strong and closely spaced; growth laminae infrequent.

To this species have been assigned a series of delicate, depressed pedicle interiors whose surface characters are in doubt. The intramarginal ridge is low and weak, the vascular channels straight and narrow, and the genital area nearly smooth. The diductor scars are acutely flabelliform, with sharp boundaries; the linear adductor scars are on a narrow septum. Teeth are low and weak. Two specimens from the

Decorah of Minnesota show similar characters but are much larger, with produced extremities. Unfortunately, their muscular regions are poorly preserved.

Remarks.—This form suggests thin specimens of *S. vetusta* (James) of the Richmond in general appearance, though its size is much less. If the association of pedicle interiors with exteriors is correct,—and there seems little reason to doubt that it is—the resemblance is borne out by the muscle scars.

Occurrence.—Decorah formation, two and a half miles west of Ste. Genevieve, Mo. Collected by Dr. Stuart Weller.

STROPHOMENA VETUSTA (JAMES)

PLATE IX, FIGS. 9-11.

Streptorhynchus (*Strophomena*) *vetusta* James, Cin. Quart. Journ. Sci., vol. 1, p. 241. 1874.

Strophomena vetusta Foerste, Bull, Sci. Lab. Denison Univ., vol. 17, p. 98, pl. 6, figs. 2 a-h. 1912.

Remarks.—This species, typical of the Waynesville and Liberty members of the Richmond, is illustrated here because of its resemblance to *S. delicatula* of the Decorah. Attention already has been called to the similarity in surface markings, and shape; comparison of figures of pedicle interiors will show that the relationship also is indicated by the muscle scars.

The kinship of these Decorah and Richmond types of *Strophomena* substantiates the observations made on *Zygospira* and other fossils from the same horizons. The Decorah fauna is markedly like that of the Maquoketa, a Richmondian formation of Iowa and Minnesota; it now appears that a similar, though perhaps less marked relationship exists between the Decorah fauna, and that of Richmondian strata in the Ohio valley.

This relationship, moreover, modifies the one which might be inferred to exist between *S. vetusta* and *S. vetusta praecursor* Foerste of the lower Waynesville. With the *S. vetusta* type established in the Black River, it is doubtful that the

variety *praecursor* is genetically what its name implies. Unfortunately, few general principles have been established for Strophomenid evolution, to furnish a court of appeal when stratigraphic evidence is not conclusive. However, the thick shell, strong internal markings, and weakening costae of the variety *praecursor*, when compared with similar characters in other brachiopods, indicate an aging form rather than a youthful one; a terminal rather than an ancestral position.

Should this interpretation be correct, the following series of events may be postulated: The *S. vetusta* type reached the Mississippi basin during the middle Black River epoch (late Plattin or earliest Decorah) in the form of *S. delicatula;* it disappeared during the Cincinnatian proper, but like many other Plattin types, did not become extinct. In the Richmondian it appeared first in the aberrant, senescent form *S. vetusta praecursor*, which gradually gave way before the true *S. vetusta*, a modified but not radically changed representative of the Black River line.

STROPHOMENA NEGLECTA (JAMES)

PLATE VIII, FIGS. 8-9.

Streptorhynchus neglecta James. Paleontologist, no. 5, p. 41. 1881.

Strophomena neglecta Foerste, Bull. Sci. Lab. Denison Univ., vol. 17, pl. 5, figs. 1-3; pl. 7, fig. 5; pl. 9, fig. 1; pl. 11, fig. 10. 1912.

(For additional bibliography see Bassler, Bull. 92, U. S. Nat. Mus.)

Remarks.—Like Strophomena vetusta, the species *neglecta* of the Richmond is included here for comparison with forms found in the Decorah—*S. dignata* and *S. musculosa.*

In general shape, *S. musculosa* resembles *S. planumbona* of the Richmond as closely as it does the typical, thick-shelled *S. neglecta.* The alternations of striae, however, place it in the group of the latter; and this relationship is apparent also in the internal characters of the pedicle valve. Although

there are striking differences, such as larger diductor scars and absence of pustules in the Decorah form, the general similarities are made clear by the photographs.

It is these same internal characters which furnish data on the relative racial ages of the two species. From shape alone *S. musculosa* might well be considered more clearly senescent than *S. neglecta;* but the heavy, elaborate muscle scars of the latter show the contrary to be true. Both *neglecta* and *musculosa,* in turn, are radically older than *S. dignata* of the Missouri Decorah. The group forms another example of the intimate relationship existing between elements in the faunas of the Decorah and Richmond.

EXPLANATION OF PLATES

Plate VIII

FIGURE

PAGE

1— 7 *Strophomena musculosa* n. sp. ---------- 153
1 Interior of a pedicle valve, the holotype. (W. M. 25524)
2 A paratype with heavy scars. (W. M. 25527)
3 A small paratype bearing strong growth lamellae. (W. M. 33421)
4 A young individual resembling the one of Fig. 6, but with non-crenulate extremities. (W. M. 33421)
5 Interior of a brachial valve. (W. M. 25527)
6— 7 Pedicle and brachial views of a large specimen, the allotype. (W. M. 25525)
8— 9 *Strophomena neglecta* (James) ---------- 157
Interiors of two large, well-marked pedicle valves, for comparison with Figs. 1—2. (W. M. 25544)

Plate IX

FIGURE

PAGE

1— 3 *Strophomena auburnensis* n. sp. ---------- 148
1 Interior of a pedicle valve, the holotype. (W. M. 25521)
2 Brachial view of the allotype. (W. M. 25522)
3 Surface of the pedicle valve of the allotype, near beak, x 3.
4— 6 *Strophomena delicatula* n. sp. ---------- 155
4 Brachial view of the allotype. (W. M. 33400)
5 Pedicle interior, the holotype. (W. M. 25537)

6 A large pedicle valve, referred with doubt to this form. (W. M. 25538)

7 *Strophomena* sp. ---------- 154
Brachial valve of a large, highly convex *Strophomena* from the Decorah of Ste. Genevieve Co., Mo. (W. M. 25543)

8 *Strophomena winchelli* Hall and Clarke---------- 150
Interior of a typical pedicle valve, Plattin of Ste. Genevieve Co., Mo. (W. M. 25513)

9—11 *Strophomena vetusta* (James)---------- 156

9 Interior of a pedicle valve, one of the cotypes. (W. M. 25545)

10—11 Brachial and pedicle views of a large, typical specimen. (W. M. 1567)

PLATE X

FIGURE PAGE

1— 2 *Strophomena inconsueta* n. sp.---------- 154

1 Interior of a pedicle valve, the holotype. (W. M. 25987)

2 Exterior of a typical pedicle valve. (W. M. 25989)

3— 5 *Strophomena dignata* n. sp.---------- 151

3 Brachial view of the allotype. (W. M. 25533)

4 Interior of a pedicle valve, the holotype. (W. M. 25532)

5 Interior of an elongate pedicle valve. (W. M. 25535)

6 *Strophomena exigua* n. sp. ---------- 152
Interior of a pedicle valve, the holotype. (W. M. 25956)

7— 9 *Strophomena plattinensis* n. sp. ---------- 149

7 Interior of a pedicle valve, the holotype. (W. M. 25988)

8 A small paratype with coarse costae. (W. M. 25501)

9 A large brachial valve, wrinkled at the extremities. (W. M. 25983)

A NEW SPECIES OF SCHIZOPHORIA FROM THE DEVONIAN OF IOWA[1]

By MILDRED ADAMS FENTON AND CARROLL LANE FENTON

For some years we have been familiar with a member of the genus *Schizophoria* which, in the reports of the Iowa Geological Survey, commonly has been referred to *S. mcfarlanei* (Meek). Careful comparison with Meek's figures, however, show the reference to be incorrect, while comparison with other described species of the genus from America and Europe indicate that the Iowa form, whatever its proper taxonomic rank, is distinct. Accordingly, we submit this description of it, with the name of the author with whose species it most often has been confused: Meek.

SCHIZOPHORIA MEEKI N. SP.

PLATE XI, FIGS. 1-8.

Orthis (or *Schizophoria*) *mcfarlanei* auctt.

Not *Orthis mcFarlanei* Meek, Trans. Chicago Acad. Sci. vol. 1, pt. 1, p. 88, pl. 12, fig. 1. 1868.

Description.—Shell of medium size, with length and width about equal in adult specimens. Dimensions of the holotype, (which is an incomplete brachial valve), a normal specimen, and an unusually tumid one: length of pedicle valve ——, 24.6 and 25.3 mm.; width 26.6, 25.3 and 22 mm.; thickness ——, 21 and 20 mm.; length of hinge line 14.8, 15.5 and 11.4 mm.

Pedicle valve markedly convex umbonally, sloping gently to the cardinal, and still more gently to the anterior margins. Sinus appears only as a broad, shallow depression in the anterior half of the valve. Beak sharp, slightly incurved;

[1] Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 5.

cardinal area broadly triangular, with an average height of about 3 mm.

Brachial valve very highly convex, particularly in senescent and narrow specimens. Umbo produced slightly beyond the cardinal margin; beak blunt and slightly incurved; cardinal area broadly triangular. In most specimens there is no mesial fold; a few show a depression. Internally, the cardinal process is small and angular, with sharp lateral ridges; it extends forward about 2 mm. Crural plates heavy, and less widely divergent than in many members of the genus; in the holotype their length is 3.5 mm. Dental sockets deep; muscle scars deep, with strongly elevated margins, their general character being shown adequately by Fig. 1. Vascular sinuses deep; in the holotype they extend more than two-thirds of the distance to the anterior margin.

Remarks.—As has been said, this form commonly has been confused with *S. macfarlanei* (Meek), from which it differs in its greater proportionate length, narrower hinge-line, more rounded lateral margins, and finer costae. In general, specimens from the lower Cedar Valley ("Upper Wapsipinicon") resemble the Canadian species more than do those from higher beds.

Occurrence.—Acervularia? profunda zone of the Cedar Valley stage, particularly in the neighborhood of Waverly, Iowa; also in strata which we consider to be of Cedar Valley age at Solon, Iowa, where it is common in beds characterized by *Atrypa independencis* Webster.

Holotype.—No. 25,993; *Paratype.*—No. 7465, Walker Museum; *Allotype.*—No. 347; *Paratype.*—Nos. 348-350, University of Cincinnati Museum.

PLATE XI

FIGURE PAGE

1— 8 *Schizophoria meeki* n. sp. ---------- 160

1 Internal view of the holotype, showing the thick shell, heavy muscle scars and deep vascular sinuses. Waverly, Ia. (W. M. 25993)

2 Brachial view of a paratype. (W. M. 7465)

3— 5 Brachial, posterior and lateral views of a thick, narrow paratype. The shell was much worn before fossilization, and the drawings purposely obscure many of its irregularities. Solon, Ia. (U. C. M. 348)

6— 8 Lateral, brachial and posterior views of the Allotype, in which the cardinal area is exceptionally high. Solon, Ia. (U. C. M. 347)

Book Review

TARKA THE OTTER;
By Henry Williamson—
E. P. Dutton & Co., New York.

The naturalist, the litterateur, and even the lover of thrills will pay this book the tribute of more than one reading. This is to say that it has an appeal for more than the specialist. It is also to say that the author has combined the qualities of a trained observer, a meritorious sense of literary values and a fetching human appeal. Though the fascinating story of Tarka the Otter is the purpose of the book, Mr. Williamson may be said to have included in it a word story of every minute thing that Tarka touched upon in his adventurous career. The salt of the sea, as well as the tree-laced river and the murmurous meadow, has each its turn in delighting the reader. And over it all hangs the breathless suspense of the life long conflict between Tarka the Otter and Deadlock, the hound. The temptation to quote comes too often for the space allotted for review and the fear of passing over one excellence for another. As an example of literary economy, however, witness this, so reminiscent of Celtic brevity: *"White-tip awakened before Tarka by the time of an eye-blink."* Or this that betrays the patient lover of nature: *"Uch, uch!* gasped the seal, exhausted and aching after her anguished journey over the boulders of the cavern. She had hurried by pressing the palms of her flippers on the ground and lifting her body forward by short jumps, moving fast as a walking man. She reached her cub and caressed it with her tongue, making sounds over it between sobbing and bleating. Then she turned

her back to the man, and flung sand and pebbles at him with quick scooping strokes of her flippers. The man took from his pocket a wooden whistle, made from an elderberry stick, and played several soft notes upon it. The seal looked at him, enjoyed the rude music. She lay still and happy with her calf, whose head was turned on one side as it sucked through the side of its mouth. The man played on, moving nearer to the seal. Slowly he bent down to stroke its head, and the seal licked his hand." Or this that is so human in the final conflict: "At the beginning of the eighth hour a scarlet dragonfly whirred and darted over the willow snag, watched by a girl sitting on the bank. Her father, an old man and humped as a heron, was looking out near her. She watched the dragonfly settle on what looked like a piece of bark beside the snag; she heard a sneeze, and saw the otter's whiskers scratch the water. Glancing round, she realized that she alone had seen the otter. She flushed, and hid her grey eyes with her lashes. Since childhood she had walked the Devon rivers with her father, looking for flowers and the nests of birds, passing some rocks and trees as old friends, seeing a Spirit everywhere, gentle in thought to all her eyes beheld."—*L. V. B.*

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THE SHELLROCK STAGE OF THE DEVONIAN OF IOWA[1]

C. H. BELANSKI

III. STRATIGRAPHIC AND FAUNAL RELATIONSHIPS.

Previous work upon the Shellrock strata, particularly that of Calvin, has consisted largely or correlations based upon the presence of spheroidal stromatoporoids. Reefs and beds of such stromatoporoids occur at Waterloo, Charles City, Marble Rock, Nora Springs, Mason City, and at many other localities.

Unfortunately, very few of the stromatoporoids composing these reefs are known sufficiently well to permit even generic identification. Very few of them exhibit distinct external form, or can be recognized from broken sections. Clearly, then, these fossils are unsuitable for indices and it is not to be wondered that correlations made upon their evidence have proved to be erroneous.

An example of such an error is to be found in the correlation of the beds of spheroidal stromatoporoids at Mason City. Without actually tracing these beds Calvin[2] nevertheless correlates them with apparently similar beds near river level at Nora Springs, which in turn he correlates with still other stromatoporoid beds at Marble Rock. Now

[1]Parts I and II of this paper appeared in this journal, vol. 10, pp. 317-370, 1927.

[2]Ia. Geol. Surv. vol. 7, pp. 145-146, 1897.

by careful tracing[3], Calvin's stromatoporoid beds at Mason City are found to be the equivalent of the First Actinostroma zone, which lies some twenty-five feet above the stromatoporoid bed (Pachyphyllum zonule) along the river at Nora Springs. On the other hand, similar tracing shows that the Nora Springs reef is represented at Mason City by dolomite and shales occupying a horizon some fifteen feet below the stromatoporoid beds of Calvin. Again, tracing this Nora Springs reef southward it is seen to feather out and disappear far short of the points where the spherical stromatoporoid beds of the Marble Rock section appear. The reef so conspicuously shown in the Marble Rock sections lies from ten to twenty-five feet below the horizon of the Pachyphyllum zonule.

Although the general shape and character of the stromatoporoids of the Marble Rock reef, and to a certain extent the lithology of the beds, are similar to that of the Pachyphyllum zonule, they are accompanied by a brachiopod-molluscan fauna that is widely different from that of the Pachyphyllum beds or from any faunule to be found in the Shellrock. The Marble Rock reef is equivalent to similar stromatoporoid beds shown at Floyd but the stromatoporoid reef at Charles City lies well below the horizon of the Floyd-Marble Rock reef and carries a slightly different brachiopod-molluscan fauna. Although these two sets of reefs occupy a horizon that would indicate Cedar Valley age, their correlation with similar stromatoporoid reefs at Waterloo, Garrison and Iowa City must be regarded as doubtful until careful tracing shows their exact relationships.

Having for the present abandoned the stromatoporoids as means of correlating these two sets of strata, we must

[3]Although sections are not given in the present paper, the strata of the Shellrock have been traced in numerous exposures along Lime Creek from Rockford to Fertile, and the results obtained have been checked by sections of the strata along the Shellrock which are given in the present paper.

turn to other fossils for criteria to determine their relationships. Although the greater part of the Cedar Valley fauna of Iowa is unstudied, certain diagnostic forms are described in papers by Hall,[4] Thomas,[5] and other authors. Of these fossils there may be mentioned *"Acervularia davidsoni"* M.-E. & H., *"Acervularia profunda"* Hall, *Codaster subtruncatus* (Hall), *Nucleocrinus obovatus* (Barris), *Melocrinus nodosus* Hall, *Megistocrinus farnsworthi* White, *M. latus* Hall, *M. pernodosus* Thomas, *Spirifer iowensis* Owen,[6] *S. asper* Hall, *Gypidula comis* (Owen) and *Pentamerella dubia* (Hall).

Were the Shellrock beds of Cedar Valley age we would expect to find some, if not all, of these species in their fauna. However, not one of them is known to occur in the Shellrock, the diagnostic fossils of which are *Trigonotreta shellrockensis* n. sp. *Camarophoria paupera* Belanski, *Lepidocentrus ? thomasi* n. sp. *Pachyphyllum websteri* n. sp. *Hexacrinus springeri* Thomas, *Strobilocystites schucherti* Thomas, *Cylindrophyllum floydensis* n. sp., *Phillipsastrea minutissima* (Webster), and *Stropheodonta cicatricosa* n. sp. Of these species not one occurs in known Cedar Valley faunas. Of the nearly three hundred species known from the Shellrock less than ten percent are related to or identical with Cedar Valley species. Clearly then the Shellrock fauna points to separate age.

Turning now to stratigraphy, we find that the Shellrock beds differ widely in lithologic character from the Cedar Valley of the same area, and from the Cedar Valley of the central and southern parts of the state. Moreover, the succession of beds is such that they can not be correlated with the true Cedar Valley strata.

Equally important is the fact that wherever their contact is exposed, the Shellrock strata are separated from

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[4]Geol. of Iowa, vol. 1, pt. 2, 1858.

[5]Ia. Geol. Surv., vol. 29, 1924.

[6]Recent study of this brachiopod indicates strongly that it belongs to the genus *Platyrachella*.

those of the Cedar Valley by a sharp, persistent unconformity. In the erosion interval thus indicated from two to ten feet of very durable limestones were removed. Not only were the Shellrock strata deposited in a basin eroded in the Cedar Valley, but they also overlap upon the Cedar Valley in their southern and eastern phases. Thus at Nora Springs the Aulopora zone, some fifteen feet thick, forms the basal zone of the Shellrock. At Rockford the thickness of this zone decreases to seven feet and at Marble Rock it is absent. From Marble Rock southward the Trigonotreta zone forms the base of the stage, and like the Aulopora zone, thins to the southeastward, first by the feathering out of the basal shaly zonule, and at Greene, by the thinning of the Stropheodonta zonule. As a result the thickness of the Mason City substage decreases from twenty-two feet at Nora Springs to less than four feet at Greene.

Throughout the Shellrock there are numerous unconformities showing that the advance of the sea was irregular. None of these unconformities, however, approach the significance of the one at the base of the stage as in many cases beds separated by unconformities in one phase may be merged together as a unit in another phase. Furthermore, the faunas above and below the unconformities show close relationships. The most pronounced intraformational unconformity is that at the base of the Nora Substage, but above it appear abundant fossils found in the basal zones of the stage. These numerous breaks in sedimentation must have been caused by slight oscillations in the level; they indicate the closeness of the eastern margin of the basin, which is also indicated by the rapid thinning of the several members to the south and east.

So much, then, for the separation of the Shellrock strata from the underlying Cedar Valley. It remains to determine their relationship to the overlying beds.

Resting upon the Shellrock is the Juniper Hill formation, consisting of heavy-bedded fine mud-shales carrying a fauna which contains not a single Shellrock species and

but few Shellrock genera. Wherever observed, the contact between the two formations is sharply unconformable, made clearer by the sharp lithologic break. There is no evidence, however, that the unconformity has resulted from the removal of any great thickness of Shellrock strata, even though evidence of an erosional contact is clear.

Overlying the Juniper Hill formation are the shales, shaly limestones, and dolomites of the Hackberry stage. While lithologically distinct from the Shellrock strata, and separated from them by some fifty feet of shale bearing a wholly distinct fauna, the Hackberry shows considerable faunal similarity to the Shellrock. Although but few species are common to both stages, there are many genera whose species are closely related. In *Cranaena, Trigonotreta, Platyrachella, Camarophoria, Devonocidaris, Nortonechinus, Platyschisma, Phillipsastrea, Alveolities* and *Tabulophyllum* are many Shellrock species which apparently are ancestral to Hackberry forms.

It might be inferred from the previous statements that the Shellrock fauna is a mixture of Cedar Valley and Hackberry types, however, this is not the case. It is true that about ten percent of the Shellrock fauna is most closely related to Cedar Valley species, and about twenty per cent find their closest relatives in the Hackberry fauna; but the remaining seventy per cent, though containing less than half the specimens found, comprise the diagnostic Shellrock fauna, and the proportion probably will be increased when the stromatoporoids are described. Some of the genera containing typical Shellrock species are *Eatonia, Lepidocentrus* ?, *Pachyphyllum, Hexacrinus, Craspedophyllum, Coenites,* and *Sieberella.*

A study of the species, thus far, indicates that the Shellrock fauna has an origin distinct from either the Cedar Valley or the Hackberry faunas. From the relationships now known it would seem that the ancestral fauna of the Shellrock must be sought in the Devonian of the Mackenzie basin, or more remotely, in that of the German Eifel.

IV.—SUMMARY.

I. The Shellrock strata, as here defined, form a distinct stage in the upper Devonian of Iowa which is:

   A. Composed of beds different in character from those of the Cedar Valley stage, bearing distinct faunas, and separated from the Cedar Valley by a marked and persistent unconformity, representing the erosion of two to ten feet of very durable lithographic limestone.

   B. Composed of beds lithographically and faunally distinct from those of the overlying Juniper Hill formation, which everywhere is unconformable upon the Shellrock.

   C. United throughout its several members by a faunal similarity, despite the numerous unconformities within the stage, none of which approach in significance those which define it.

II. The Shellrock strata were deposited in a basin upon eroded Cedar Valley rocks, in a sea which was advancing southward, as is shown by the progressive overlap upon the Cedar Valley beds.

III. The Shellrock sea advanced irregularly, with many oscillations and retreats, as is shown by the numerous unconformities within the stage, some of which, however, may represent subaqueous erosion.

DESCRIPTIONS OF SOME TYPICAL FOSSILS OF THE SHELLROCK STAGE[1]

C. H. BELANSKI

I.—INTRODUCTION.

In my account of the stratigraphy of the Shellrock stage, completed in the present number of this magazine, reference has been made to the fact that most of its typical fossils belong to species that have not heretofore been described. The purpose of this paper is to provide descriptions and illustrations of such forms as are mentioned.

It will be noted that each description is accompanied by a paragraph giving the location of the types. The abbreviations used in these paragraphs are as follows:

C. H. B.—Collection of C. H. Belanski
U. C. M.—University of Cincinnati Museum
U. S. N. M.—United States National Museum
W. M.—Walker Museum, the University of Chicago.

II.—DESCRIPTIONS OF FOSSILS.

Phylum COELENTERATA

Class ANTHOZOA

PACHYPHYLLUM WEBSTERI N. SP.

Plate XII, Fig. 3.

Description.—Corallum formed of confluent corallites that originate by septal and marginal-calycinal gemmation, and which diverge from a common base to form irregular convex or hemispherical masses reaching 40 cm. in greatest diameter and 15 cm. in thickness, the area of attachment commonly being confined to the original corallite.

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[1]Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 6.

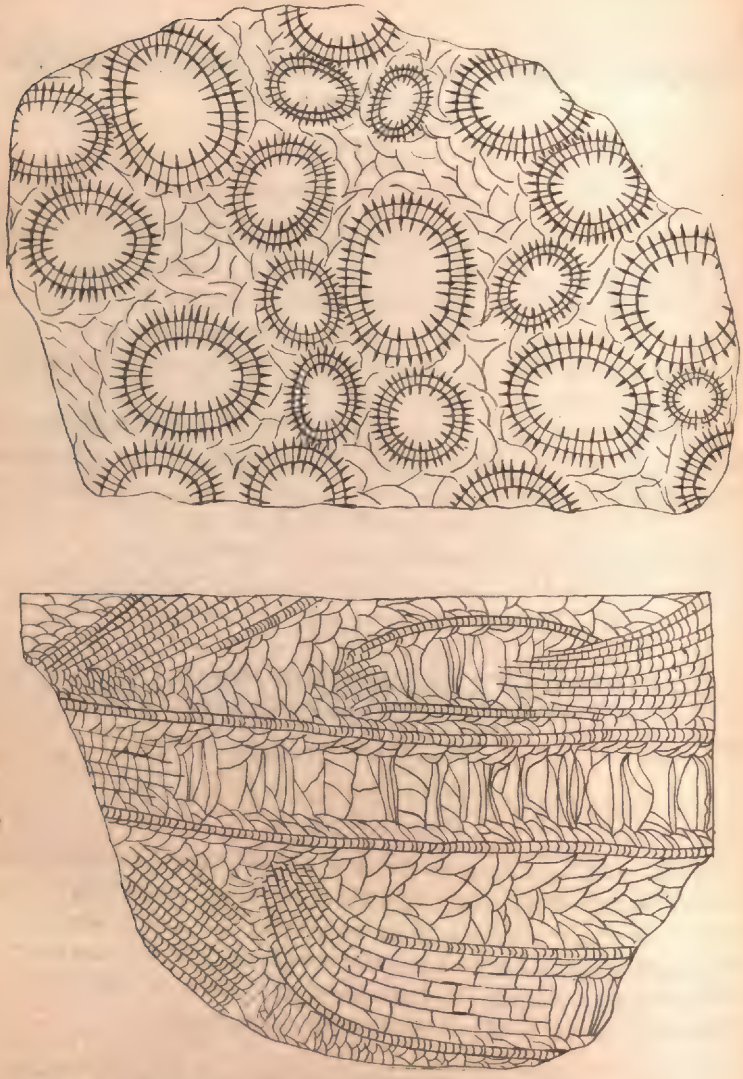

Fig. 1.—A vertical and a transverse section of a corallum of *Pachyphyllum websteri* showing the double mural ring, non-confluent septa, tabulae of the intra-mural area etc. x3.

Corallites 6 to 14 mm. in diameter, without well defined margins. The central portion of each consists of a deeply depressed pit (the intramural area), surrounded by an exsert ring (the mural area), which in turn is surrounded by a depressed area (the extramural area) which extends to the margins of the corallite. The diameter of the exsert rings varies from 5 to 11 mm. and their elevation above the extramural area from 2 to 11 mm.; the bottom of the intramural pit is about on the same level as the extramural area. Mural walls thick and nearly vertical; their upper rims sharply rounded.

Bottom of the intramural pit flat or gently concave, bearing a small, smooth transverse diaphragm. Septa 32 to 48 in number, apparently smooth. On the inner mural wall the primary septa extend to the margins of the diaphragm, the secondaries being very fine and reach but a short distance down the wall. Both sets of septa are of equal strength at the top of the exsert mural ring and extend downward and outward over the extramural area where they meet those of adjoining corallites and fuse with them.

In a vertical section the mural wall is seen to be double, being composed of very small, vertically arranged dissepiments the inner and outer walls of which are heavier than those above and below. The intramural area is divided into a central tabulate zone which is about two-thirds the width of the area and which is surrounded by a zone of dissepiments that extend to the inner mural wall. Tabulæ flat or gently convex, very irregularly spaced; in some places 2 mm. apart, in others crowded, 2 to 4 in the space of a millimeter. Dissepiments small, inclined upward and outward, commonly enroaching upon the tabulate zone. The extramural area composed of large irregular dissepiments which are confluent with adjoining corallites.

In a transverse section the mural area of each corallite appears as a large double-walled ring which bears a short cycle of primary and secondary septa. Both sets of septa project about 1 mm. beyond the outer wall of the ring

where their ends are abruptly pointed. On the inner side of the area only the primaries are shown as sharp points which extend less than 1 mm. into the intramural area. The secondary septa extend only to the second or inner ring of the area. The septa on the outer wall of the area are never confluent with those of adjoining corallites even when the rings are so closely crowded as to be almost in contact. The extramural area shows only large dissepiments.

Remarks.—From the fact that the septa of adjoining corallites are not confluent internally, this species appears to be the only representative of this genus which is known in Iowa. The various corals from the overlying Hackberry beds, which have been described as species of *Pachyphyllum*, all show confluent septa internally, a feature which places them in the genus *Phillipsastrea*. The only other member of *Pachyphyllum* known to occur in America is *P. devoniense* M-E. & H. which occurs in the Devonian of the Peace River district of Canada. From that species *P. websteri* differs in having primary septa which do not reach to the center, more irregular tabulae, and more closely spaced mural rings. Specific name in honor of the late Clement L. Webster.

Occurrence.—Confined to the Aulopora zone, being most common in the Pachyphyllum zonule at Nora Springs. Specimens are never abundant and have a very limited geographic range.

Holotype.—No. 2176; *Paratypes.*—Nos. 529, 626, 646, C.H. B., No. 71030, U.S.N.M., Nos. 1470 and 1478, U.C.M.

PRISMATOPHYLLUM OWENI N. SP.

Plate XII, Fig. 2.

Description.—Corallum composed of polygonal, intimately united corallites which increase by interstitial gemmation, diverging from a common base to form large irregular convex masses up to 20 cm. in diameter and often of equal or greater thickness. Marginally, or rarely centrally, the corallites tend to grow independently and in such cases

they are covered by a heavy continuous, transverely wrinkled epitheca.

Corallites 5 to 14 mm. in diameter; usually polygonal with their margins sharply angular and rather strongly elevated; although independent corallites are subcircular in section with the outer margins gently rounded outward and downward. Calyces nearly as deep as wide, the walls at first sloping gently toward the center, near which they descend abruptly to form a deep flat-bottomed pit whose diameter is one-third to one-half that of the corallite and whose depth, as a rule, is nearly twice the width. The bottom of the pit bears a small transverse diaphragm. Septa 34 to 40 in number, strong and prominent, their crests marked by rounded denticulations. The primary septa reach the margins of the central diaphragm, the secondaries generally fail to reach the margins of the depressed pit.

Vertical sections show each corallite to be bounded by a thin but definite wall with a tabulate area occupying more than one-third of the central portion. Tabulae thin; 1 to 3 in the space of 1 mm.; their central third is flat or gently convex, their outer area gently deflected; many are confined to the central, more flattened portion. Surrounding the tabulæ is a broad region of flattened dissepiments directed upward and outward. In a transverse section the primary septa reach about half way to the center, and the secondary septa are marginal.

Remarks.—The most closely related coral from the Iowa Devonian is the one described by Hall[2] as *Acervularia davidsoni* ? M-E. & H. from the Cedar Valley beds of Johnson and Black Hawk counties, but which is quite unlike authentic specimens of *A. davidsoni* from Ferques, France. However the present species differs widely from the Cedar Valley form in the deeply depressed central pit. The specific name is in honor of David Dale Owen.

[2]Geol. of Iowa, vol. 1, pt. 2, pp. 476-477, pl. 1, figs. 8a-b, 1858.

Occurrence.—Common in the Prismatophyllum zonule at Rudd and in the Macgeea zonule north of Nora Springs. It is also more or less common in the Strobilocystites zonule at Rockford. Types from the Prismatophyllum zonule.

Holotype.—No. 471; *Paratypes.*—Nos. 134, 1522, C.H.B., No. 71041, U.S.N.M., and No. 1474, U.C.M.

CYLINDROPHYLLUM FLOYDENSE N. SP.

Plate XII, Fig. 1.

Description.—Corallum composed of small cylindrical highly flexuous corallites, which increase rapidly by lateral gemmation and diverge from a common base to form flattened or irregularly convex masses reaching 40 cm. in diameter from 6 to 10 mm., generally closely crowded and more or less fused in their lower portions, their upper portions being separated by intervals ranging from one-third to more than twice their diameter. In most cases each corallite bears but one bud which expands rapidly and soon gives forth a similar bud, the vertical intervals between them ranging from 3 to 30 mm. or more. Some corallites bear two, or rarely three, buds before being overgrown by the lateral expansion of later corallites, whose rapid increase generally leads to the extinction of the parent ones. Epitheca strong and generally continuous, marked by numerous transverse constrictions and annulations of growth, the latter generally bearing small nodose expansions which, depending on proximity, may or may not fuse with similar expansions from adjoining corallites. When well preserved the epitheca is further marked by faint, rounded costal grooves corresponding to the septa beneath.

Calyx varies in depth from one-third to three-fourths of the diameter; bottom rounded, bearing a small, central depressed pit occupied by a narrow transverse diaphragm. Walls of the calyx curve steeply upward, their margins being slightly reflected outward. Septa strong, straight, neither denticulate nor crenulate, 30 to 34 in number. Sec-

ondary septa thinner than the primaries, extending less than one-half the distance to the center. The primary septa reach the margins of the central diaphragm.

A vertical section shows a central tabulate zone occupying more than one-third the diameter, and an outer dissepimental zone. The tabulæ are strong, moderately convex, from 2 to 5 in the space of 1 mm. The dissepiments bordering the tabulate area are large and nearly horizontal; those bordering the outer wall are about one-half their size and are directed upward and outward. Transverse sections show the outer ends of the septa to be thickened and fused to form a thin outer wall.

Occurrence.—Very common in both members of the Lepidocentrus zone at Nora Springs, ranging southward to Greene and Northward to the Bjorgason phase.

Holotype.—No. 2001; *Allotype.*—No. 1361; *Paratypes.*—Nos. 364, 753, 2003, C.H.B., No. 71029, U.S.N.M., and No. 1477, U.C.M.

Phylum ECHINODERMATA

Class Crinoidea

BACTROCRINUS WESTONI N. SP.

Plate XIII, Figs. 35-37.

Description.—Specimens of medium size, with elongate calyces and slender isotomous arms. All plates of the calyx smooth, very slightly depressed along the sutures. The IBB and BB united by close suture to form a gently tapering cone, the proximal diameter of which is but slightly greater than the width of the stem. IBB 5, pentagonal, subequal, slightly higher than wide. BB 5, their height from 3 to 4 times their greatest width, gradually widening upward their upper portions gently outcurved; 3 of them hexagonal, the r. post. and r. ant. truncated above and heptagonal in outline. RA missing in all specimens noted although its size and shape can be told from the sutures of adjacent plates; apparently small, quadrangular, resting directly

upon the truncated r. post. B and supporting a pentagonal tube plate; a portion of its right side fitting into a recess in the lower left side of r. post. radial. Anal X hexagonal, in line with, and slightly smaller than the RR, resting on the adjacent shoulders of the two posterior BB, and partially supporting two tube plates; its right side separated from r. post. R by RA and t.p.

RR 5, about as wide as high; the anterior and l. ant. RR. pentagonal, the r. and l. post. RR hexagonal, the r. ant. R quadrangular and resting directly upon the truncated r. ant. B; in contact with each other for nearly their entire length, the facet slightly narrower than the greatest width of the RR, the surface of the plate below the facet somewhat rounded outward. IBr very slightly cuneate, nearly as high as wide, the full complement shown only on the r. ant. ray of the paratype where they are 5 in number, the upper being a IAx. Several series of brachials beyond the IBr are shown on the allotype; they are moderately cuneate, generally higher than wide, from 8 to 10 in the IIBr, IIIBr, and IVBr series. Each brachial above the IBr bears a delicate ramule near the top of its wider side. Ventral sac unknown. Stem round or obtusely pentagonal, composed of uniform ossicles which bear cirri along the lower portion of the stem.

Remarks.—The above description is based upon several incomplete specimens, which together give a fairly good idea of the appearance of the species when complete. The holotype consists of a united set of IBB and BB, with the proximal stem ossicle. A paratype shows the RR, most of the IBr, and a few of the IIBr and part of the base of the anal system. Still another specimen, the allotype, shows a group of slender ramulate arms. A paratype, preserving but one side of the calyx, shows 2 elongate BB, 3 RR and a few of the IBr. In addition, several hundred separate plates serve to supplement observations based upon the above specimens.

The genus *Bactrocrinus* has hitherto been known only

from the Lower and Middle Devonian of Germany; its occurrence in the Iowa Devonian is interesting and serves to further emphasize the relationship between the faunas of the German and the Iowa Devonian. With it are associated *Nassoviocrinus* and *Trigonotreta* both of which are found with *Bactrocrinus* in the German Devonian. No other crinoid from the Iowa Devonian approaches this species closely enough to warrant comparison. Specific name in honor of Dr. B. F. Weston of Mason City, an enthusiastic collector of local fossils.

Occurrence.—Confined to the Trigonotreta zone, being particularly common in the Bactrocrinus zonule[3] at Rockford and in the Nassoviocrinus zonule at Nora Springs. At both points its scattered stems and plates occur by the thousand, and compose the greater portion of these beds.

Holotype.—No. 1675; *Allotype.*—No. 1980; *Paratypes.*—Nos. 1982 and 1861, C.H.B.

NASSOVIOCRINUS GOLDRINGAE N. SP.

Plate XIII, Figs. 38-39.

Description.—Specimens of medium size, with elongate crown and the IBr arrangement characteristic of the genus. Calyx turbinate, rather low, about as wide as high; IBr filling the distal faces of the RR. Surface of the plates smooth. Rounded pits mark the distal corners of the BB and broad depressions set off the sutures between them. Similar but smaller pits locate the distal angles of the IBB and of some of the RR. Arms universal, dichotomous. Stem pentalobate, tapering very gradually, every fifth or sixth columnal slightly wider than the others and generally bearing cirri, especially on the lower portions of the stem. Dimensions of the holotype: width at top of BB 5.8 mm.; height to top of BB 4.9 mm.; height to top of IAx 18.7 mm.; total length to top of IIBr 7 28.3 mm.

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[3]The Bactrocrinus zonule replaces the Poteriocrinus zonule of parts I and II and the term Nassoviocrinus zonule replaces the Decadocrinus zonule as there used, the two crinoids here described being the forms previously referred to *Poteriocrinus* and *Decadocrinus*.

IBB five, pentagonal, about twice as wide as high, united to form a low ring whose diameter is considerably greater than the proximal stem ossicle. BB five, nearly as wide as high, the two posterior ones heptagonal, the other three hexagonal. Anal side (as seen in paratype No. 1983) of poteriocrinid character, with RA. The truncate l. post. B supports the anal X, and the r. post. B supports a large hexagonal radial. RA pentagonal, resting point downward on the adjacent shoulders of the posterior BB, truncated above and supporting a large tube plate. Anal X pentagonal, slightly smaller than the RA, its distal angle apparently rounded and turned inward, situated between RA and l. post. R, its right shoulder in contact with tube plate. All plates of the calyx firmly united by close suture.

RR five, wider than high, pentagonal except for the r. post., the entire upper face occupied by the facet. Brachial series robust, deeply rounded; IBr 7 to 8 in number, more or less cuneate, the lower ones especially so. IIBr similar to IBr, but smaller; unknown beyond IIBr 7. Pinnules short and delicate, borne alternately near the top of the wider end of each brachial. Ventral sac unknown.

Remarks.—The present species apparently is closely related to the species from the German Lower Devonian figured by Jaekel as *N. pachydactylus* (Sandberger)[4] which *N. goldringae* resembles in its pentagonal stem, reduced anal system, number of primibrachs, and in the depressed areas at the corners of the plate. In *N. goldringae*, however, the anal X and the r. post. R are separated by a pentagonal RA; whereas in *N. pachydactylus* the RA is quadrangular and the anal and r. post R are in contact. The high number of plates in the IBr series also suggest *Culmicrinus* of Jaekel[5] which, however, has a round stem, more cuneate brachials, with the calyx plates not depressed in the angles. Unfortunately none of the specimens at hand show any of the ventral sac other

[4]Jaekel, Phylogenie und System der Pelmatozoen, p. 54, Fig. 42, 1918.
[5]Ibid. p. 62, Fig. 53.

than the basal tube plates. This fact may be taken as strengthening the resemblance to *Nassoviocrinus* since if the present form had a large ventral sac such as typifies *Culmicrinus*, the preservation of one of the specimens at hand is such that at least a part of it would most certainly be shown, whereas the small ventral sac of *Nassoviocrinus* might easily be concealed. Specific name given in honor of Dr. Winifred Goldring whose Monograph on the Devonian Crinoids of New York has proved very helpful.

Occurrence.—Confined to the various members of the Trigonotreta zone, being most common in the Nassoviocrinus zonule at Nora Springs.

Holotype.—No. 1981; *Paratype.*—No. 1983, C.H.B.

Class ECHINOIDEA

Throughout the different members of the Lepidocentrus zone, at the top of the Mason City substage, there is to be found an abundance of echinoid remains. While as yet no complete, or partially complete, specimens have been found, the general character of these fossils is known from several hundred separated parts. These seem to represent the full complement of the divisions of the echinoid test. Upon these dissociated parts the following descriptions are based.

LEPIDOCENTRUS ? THOMASI N. SP.

Plate XIII, Figs. 1-16.

Description.—Ambulacral plates small, paddle-shaped, their height about one-half their width. Pore-pair rather large, slightly oblique, subcentrally located, occupying one-third or more the diameter of the plate; peripodium strong, edges angular, almost wholly surrounding the pore-pair. The outer surface of the plate bears one small perforate tubercle, located subcentrally at the narrower end of the plate and surrounded by a narrow basal terrace. The narrower end of the plate is produced into a straight slender process from one-half to two-thirds the length of the plate.

This process, as viewed from the side, is bent downward and apparently aided in imbrication. For it the term *imbricating process* is here used. Inner surface of the plate marked by a low subangular ridge, being an inward extension of the imbricating process, and continuing toward the center of the plate where it is deflected and passes between the pores to the margin of the plate. The total length of a typical plate is 4.9 mm and the height 2.0 mm.

Interambulacral plates subquadrate to subrhomboidal in outline, wider than high. Adoral margins thin and distinctly beveled; adoral suture well defined, the bevel rather abrupt, its width from one-fourth to one-seventh of the plate, the proportion being correspondingly greater on the smaller plates. Primary tubercle prominent and submarginal; mamelon round, perforated by a rather large circular foramen; neck varying from slightly undercut to a gradual slope outward and downward; flush platform rarely shown. Primary tubercle surrounded by a basal terrace the diameter of which is about three times the width of the tubercle; the margins of the terrace slightly elevated; surface of the terrace gently concave, with the curvature increasing toward the tubercle. On the smaller plates no terrace is shown. Secondary tubercles apparently imperforate, sometimes absent on the smaller plates, from one to eleven in number on the larger plates; irregularly scattered over the surface of the plate, rarely showing a tendency to form a more or less definite scrobicular ring.

Primary spines of varying sizes to correspond with the plates; uniformly slender, circular in cross-section, each terminating in a rounded or acute point, annular ring obscure. Bottom of the spine flat, its width about two-thirds the greatest diameter of the spine, marked centrally by a round, moderately deep acetabulum. Base of the spine comparatively short, expanding gradually and uniformly to the position of the annulus. Surface of the spine above the

position of the annulus marked by from 18 to 24 strong, rounded striæ or flutings.

Lantern moderately low and wide angled, the foramen magnum moderately deep, its depth being about one-fourth the height of the lantern, its width about two-thirds its depth. Maxilla strong and heavy, the peripheral surface convex and marked by a deep angular retractor scar. Tooth ridge prominent on the inner surface. Attachment of the epiphysis marked by but one narrow groove on the dorsal surface. Epiphysis narrow, very slightly arched. Rotula rather slender, notched at each end. Teeth strongly curved longitudinally, broadly V-shaped in cross section with the peripheral surface broadly rounded transversely and limited laterally by a shallow submarginal groove; adoral end of tooth with sharp edges meeting at an angle of about 80 degrees.

Remarks.—The genus *Lepidocentrus* has hitherto been represented in the American Devonian by but one species, *L. drydenensis* (Vanuxem), although some four species are known in the German Devonian. The reference of the present species to the genus *Lepidocentrus* is provisional since it differs in many important features from the genotype and other previously described members of the genus.

This species is named in honor of Dr. A. O. Thomas of the Iowa Geological Survey, whose paper on the Echinoderms of the Iowa Devonian has furnished the terminology and mode of description followed in the two echinoids here described.

Occurrence.—Restricted to the Lepidocentrus zone, being most common in the Camarophoria zonule at Nora Springs.

Cotypes.—(Iamb. plates) No. 1808, C.H.B., No. 1498, U. C.M., and No. 71032, U.S.N.M., where also there is a representative lot of spines and parts of the lantern.

DEVONOCIDARIS JACKSONI THOMAS

Plate XIII, Figs. 17-28.

Devonocidaris jacksoni Thomas, Echinoderms of the Lime Creek beds of Iowa. 13th page, 1923.

Devonocidaris jacksoni Thomas, Ia. Geol. Surv. vol. 29, pp. 500-505, pl. 50, fig. 36; pl. 51, figs. 1-26; pl. 52, figs. 1-4; pl. 53, figs. 1-7; pl. 54, figs. 1-6. 1924.

Remarks.—This species, the genotype, was described from a large number of dissociated parts found in the central portion of the Cerro Gordo substage of the Hackberry (Devonocidaris zonule). Although in the description of the interambulacral spines Dr. Thomas states correctly that the number of vertical striae is from 25 to 35, yet the enlargement shown in figure 12 of Plate 51 indicates a much smaller number. This is here mentioned so that there may be no confusion with the spines of *D. primaevus* described in this paper. Figures of some typical plates and spines of *D. jacksoni* are here included for comparison.

DEVONOCIDARIS PRIMAEVUS N. SP.

Plate XIII, Figs. 29-34.

Description.—Interambulacral plates very thin and fragile, slightly thicker at the center than toward the margins; their outlines hexagonal on the most perfect of the plates shown, the majority being incomplete. Imbrication uncertain, although one or two of the plates appear to bear traces of an adoral bevel, this feature may be due to distortion of the thin margins. Primary tubercle rather prominent, varying in position from subcentral to marginal. Mamelon round, apparently not undercut, perforated centrally by a deep round foramen; neck straight or sloping steeply downward and outward to the level of the plate. On several of the plates a low but distinct basal terrace is shown surrounding the primary tubercle, but on the majority of the plates this feature is absent. Secondary tubercles about one-third the size of the primary tubercles varying in number from 1 to 5 or sometimes absent; generally more or less closely grouped around the primary tubercle but not forming a definite scrobicular ring. Each of the secondary tubercles is perforate, and most of them are surrounded by a narrow basal terrace.

Primary spines straight, very slender, circular in cross section, terminating in an acute point. Base rather short, enlarging rapidly to the annulus above which the spine contracts somewhat more gradually for about a tenth of its length. Surface of the shaft marked by from 22 to 28, fine, rounded, slightly flexuous vertical striæ which end abruptly at the annulus.

The lantern apparently is low and wide-angled; the foramen magnum being very large, its depth equalling about one-third the height of the maxilla while its width is but slightly less. The peripheral surface of the maxilla is strongly convex and marked by a deep subangular retractor scar which occupies nearly the entire face. On the inner surface the tooth slide is prominent and the scars of attachment of the epiphysis occupy nearly all of the dorsal surface. The rotulæ are long, slender and slightly curved. The teeth are strongly curved longitudinally, the inner surface flat, the outer surface marked by two strong rounded ridges separated by an angular groove; adorally the tooth is produced into a sharp cuneate process on either side of which is a similar but much smaller process.

Remarks.—As in the case of *Lepidocentrus ? thomasi*, no complete specimens of *Devonocidaris primaevus* are known, although, with the exception of the ambulacral plates, the different parts are represented by hundreds of specimens. Close study of these, in comparison with similarly dissociated parts of the genotype, *D. jacksoni* Thomas, from the Cerro Gordo substage, shows a remarkable parallelism in general features although the corresponding parts of each species show minor differences which serve to distinguish them. The diagnostic character of the interambulacral plates of *D. primaevus* lies in the larger, more numerous secondary tubercles and in the weakly developed basal terrrace of the primary tubercle. The spines have fewer and heavier striae than those of *D. jacksoni* and the rotulae and teeth are more slender than those of the Hackberry form. The hemipyramids of the present species are very short, indicating a low, broad lantern.

Occurrence.—Confined to the Lepidocentrus zone, being most common in the Eatonia zonule of the Baumgardner phase. It is sparingly found in the Camarophoria zonule at Nora Springs.

Cotypes.—(Iamb. plates), No. 1738, C.H.B., No. 71033, U.S.N.M., and No. 1497, U.C.M.

Phylum MOLLUSCOIDEA
Class BRACHIOPODA

CRANIA MILLEPUNCTATA N. SP.

Plate XII, Figs. 4-6.

Description.—Shell subcircular to suboval in outline, generally distorted in growth so that the proportions of length and width are highly variable. Dimensions of a nearly complete brachial valve,—the holotype: width 8.7 mm; length 7.1 mm; height, 2.8. mm.

Pedicle valve unknown. Brachial valve irregularly subconical. The apex bluntly pointed, varying in position from central to a point one-third the diameter from the posterior margin, generally more or less inclined posteriorly. Surface slopes sharply to the posterior and less sharply to the anterior and lateral margins, on some specimens the surface anterior to the apex is gently convex. Surface marked by strong striæ numbering from 3 to 5 in the space of 1 mm. The striæ increase by intercalation, and on small specimens have a uniformly radial arrangement. On most specimens over 5 mm. in diameter, however, the striæ lose their regularity and in groups of 5 to 12 they are abruptly deflected to the right or left. In the areas vacated new sets originate which are deflected at high angle to the first group and which extend until they meet a set similar in direction to the first group. This irregular deflection apparently does not affect the posterior slope. Numerous alternately coarse and fine concentric wrinkles impart a crenulate appearance to the striæ.

Anterior adductor scars prominent, suboval, rather strongly elevated, their diameter as much as one-fifth of the diameter of the shell. In most cases they are located on either side of the apex, being separated by a narrow interval. Posterior adductor scars about one-fourth the size of the anterior; they are somewhat depressed in the shell floor and lie close together near the posterior margin. Entire inner surface of the valve marked by crowded punctæ, large enough to be readily visible.

Remarks.—This description is based upon nearly one hundred isolated brachial valves. Radiating striae mark such other Devonian species of *Crania* as *C. crenistriata* Hall, *C. bordeni* Hall, and *C. stewarti* F. & F. None of these, however, show the irregularly divergent striae such as characterize *C. millepunctata.* This can hardly be regarded as an accident of growth since fully 90 per cent of the larger specimens show this feature. The large closely arranged punctae are also specifically important.

Occurence.—Abundant in the Crania zonule of Ulster township, Floyd Co., Iowa.

Holotype.—No. 60; *Paratypes.*—Nos. 61, 62, 64, C.H.B., and No. 1496, U.C.M.

SCHIZOPHORIA FLOYDENSIS N. SP.

Plate XIV, Figs. 1-7.

Description.—Dimension of the holotype and of a paratype: width 29 and 25 mm.; length 23.5 and 19 mm.; thickness 17 and 14 mm.; width of cardinal area, 15 and 14 mm.; height of cardinal area 5.5 and 4.5 mm.

Pedicle valve depressed convex, its surface arching gently to the anterior and rather sharply to the cardinal margins, but sloping gradually to the lateral margins. Mesial sinus originates about one-fourth of the distance anterior to the beak; at the margin it forms a broad rounded depression nearly one-half the depth of the opposite valve. Beak prominent, moderately incurved; cardinal area large, its width more than half that of the valve; increasingly con-

cave toward the beak; its lower portion posteriorly inclined at an angle of about 120 degrees to the plane of the valve. Delthyrium large, nearly twice as high as wide. Internally, strong hinge teeth are supported by short, stout dental lamellæ which continue forward as two high, sharp ridges bounding the muscle scars. Muscular area about one-third the length of the valve, divided by a low subangular ridge which originates near the antero-median emargination, and extends less than half the distance to the beak, gradually merging with the shell floor.

Brachial valve convex, its surface arching sharply and uniformly from the beak to the anterior and less sharply to the lateral and cardinal margins. Mesial fold obsolete or indicated only by a slight flattening of the shell. Cardinal area less than one third the height of that of the pedicle valve, its upper portion slightly concave. Beak small, obtuse. Internally, the socket plates are very prominent and are supported by stout lamellæ that extend as sharp ridges bounding the muscle scars. Muscular area large, subquadrate, its anterior half divided by a slender median ridge which originates just anterior to the emargination; cardinal process large, sharply angular, continuing forward as a ridge, nearly meeting the median muscular ridge.

Surface of both valves marked by fine, rounded, tubular costæ, from 1 to 4 in the space of 1 mm.; they increase by bifurcation and intercalation, and alternate ones are considerably larger than those between. Costæ crossed by strong irregularly spaced growth constrictions between which are numerous and finer concentric lines.

Remarks.—This species differs from other members of the genus known from the Iowa Devonian in its much wider and higher cardinal area and in the more prominent pedicle beak.

Occurrence.—One of the most common forms of the Schizophoria zone, being found abundantly in all of the eastern members of that zone. It also occurs more or less commonly in the Prismatophyllum zonule of the Nora substage at Rudd.

Holotype.—No. 500; *Paratypes.*—Nos. 276, 375, 362, C.H. B., and No. 71040, U.S.N.M.

STROPHEODONTA CICATRICOSA N. SP.

Plate XIV, Figs. 11-14.

Description.—Shell subquadrate in outline; greatest width ranging from the hinge line to near the mid-length. Dimensions of the holotype and of a paratype: width 17.5 and 14 mm.; length 15 and 12.5 mm.; thickness 6.5 and 6 mm.

Pedicle valve with the greatest convexity near the mid-length, its surface arching gently from the beak to the anterior, and less strongly to the lateral and cardinal margins. Beak small, blunt, incurved; cardinal area broadly triangular, flat or slightly concave, inclined posteriorly and lying nearly in the plane of the valve; marked by fine vertical striæ. Delthyrium obsolete externally. Internally, the grooves for the cardinal apophyses are deep. Muscular area large, depressed, indistinctly bounded; divided medially by a low sharp ridge which originates shortly anterior to the cardinal, and continues more than half the distance to the anterior margin. A subangular thickening about 2 mm. wide extends around the lateral and anterior margins, being most prominent near the extremities.

Brachial valve most concave near the beak, and flattened toward the extremities where its surface is nearly flush with the cardinal margin. A sulcus extends from the beak to the anterior margin, becoming broad and shallow anteriorly. Cardinal area less than half as high as that of the pedicle valve, flat, inclined anteriorly at about 60 degrees to the plane of the valve and marked by vertical crenulations. Internally, the cardinal process is small and bifid; the apophyses are widely separated and subparallel. Muscular area strongly elevated; posterior adductor scars bounded posteriorly by heavy crescentic ridges which together are more than twice as wide as the base of the cardinal process. A low subangular median ridge extends to

the raised rim bordering the valve. Anterior adductor scars bounded by curved ridges which originate near the lateral extremities of the posterior scars and extend nearly to the middle of the valve, where they converge with the mesial ridge. About 2 mm. within the anterior and lateral margins is a rounded shelf-like ridge upon which vascular sinuses are strongly impressed. Beyond this the inner surface curves sharply downward to the margins.

Surface of both valves marked by low, subangular radiating costæ which increase by bifurcation and intercalation; from 1 to 3 in the space of 1 mm. The costæ are crossed by fine concentric growth lines which are most conspicuous on the pedicle valve Shell thick and coarsely punctate.

Remarks.—Externally this species bears a strong resemblance to certain members of the genus *Douvillina* although the internal structure is that of *Stropheodonta*. There is no described species from the Iowa Devonian which approaches this in the extremely heavy character of the muscle scars.

Occurrence.—Very abundant in the Camarophoria zonule at Nora Springs, but more or less common in all of the members of the Lepidocentrus zone.

Holotype.—No. 242; *Paratypes.*—Nos. 349, 356, 409, 176, C.H.B., No. 71038, U.S.N.M., and No. 1499 U.C.M.

STROPHEODONTA SCOTTENSIS N. SP.

Plate XIV, Figs. 8-10.

Description.—Shell strongly convex, about two-thirds as long as wide, with greatest width along the hinge line. Cardinal extremities angular, generally produced into small auriculations not sharply set off from the body of the shell; lateral margins straight or slightly concave posteriorly, becoming more convex anteriorly and passing without break into the regularly curved anterior margin. Dimensions of the holotype and of a paratype: width 39 and 46 mm.; length 26 and 33 mm.; thickness 12 and 16 mm.

Pedicle valve deepest posterior to the midlength, most convex near the beak, its surface arching gently to the an-

terior margin. Cardinal extremities arched or very slightly flattened. Surface marked by moderately strong subangular costæ which are slightly flexuous near the margins and extremities, and which increase by bifurcation and intercalation; averaging about 7 in the space of about 5 mm. Beak large, blunt, slightly incurved. Cardinal area low, flat or very slightly concave, and lying about in the plane of the valve; transversely striated. Delthyrium externally obsolete.

Brachial valve moderately concave, with shallow sulci extending toward the extremities just anterior to the cardinal margins. Surface marked by costæ similar to those of the pedicle valve, but much weaker. Cardinal area transversely striate, sublinear, its surface flat and standing about at right angles to the plane of the valve. Internally, the inner face of the cardinal border is strongly crenulated throughout its entire length, the crenulations not encroaching on the cardinal area. Cardinal apophyses large, elevated and strongly divergent, extending beyond the cardinal line, their extremities notched. Muscular area large, situated on a strongly elevated platform whose lateral margins are sharply defined by curved ridges which originate slightly anterior to the base of the apophyses and continue forward about one-third of the length of the valve where they converge and unite to form a strong rounded ridge which continues nearly to the front of the valve. Muscular area at the point of greatest width bears four faintly rounded subparallel ridges which extend from near the anterior margin of the area to the base of the apophyses. Shell thick, strongly punctate.

Remarks.—The strongly elevated muscular area distinguishes the present species from any other large *Stropheodonta* known in the Iowa Devonian.

Occurrence.—Restricted to the Trigonotreta zone, being most common in the Bactrocrinus and Stropheodonta zonules at Rockford and in the Cyrtoceras zonule at Nora Springs.

Holotype.—No. 300; *Paratypes.*—Nos. 1088, 174, 542, C. H.B., and No. 71031, U.S.N.M.

PRODUCTELLA FRAGILIS N. SP.

Plate XIV, Figs. 15-17.

Description.—Length about three-fourths the width; greatest width near the midlength; cardinal extremities rounded. Dimensions of the holotype: length 14.2 mm.; width 18.7 mm.; thickness 7.3 mm.

Pedicle valve strongly convex, prominent umbonally. Surface arching gently from the beak to the anterior margin with the greatest curvature posteriorly; rather strongly arched from the umbo to the cardinal margins; more gently to the lateral margins, which toward the extremities are sharply deflected and produced below the plane of the valve. Lateral extremities separated from the main body of the shell by a shallow sinuosity that is most marked toward the cardinal margins. Beak small, inconspicuous. Cardinal area low, well defined, triangular. Delthyrium closed by a low deltidium.

Brachial valve deeply concave in the visceral portion; deflected and somewhat flattened toward the cardinal extremities. Cardinal area linear. Internally, the cardinal process is small; the apophyses are rounded and lie nearly at right angles to the shell floor. A faint median ridge extends from near the base of the apophyses to beyond the middle of the valve.

Surface of both valves marked by strong concentric wrinkles which are most conspicuous on the brachial valve. On the pedicle valve they are strong toward the extremities and almost obsolete on the anterior and central portion. Spine bases developed only on the pedicle valve; they number from 30 to 50 and are small and irregularly spaced, being most conspicuous toward the cardinal margins where from 3 to 5 appear on each side of the beak. Shell of both valves very thin and fragile.

Remarks.—The most nearly related form from the Iowa Devonian is *Productella subalata* (Hall) of the Cedar Valley. In it the pedicle beak is prominent, the spine bases are heavy and show a tendency to concentric arrangement, and the con-

centric wrinkles are very heavy and strongly undulating. The cardinal area is linear while on *P. fragilis* it is distinctly triangular; thus resembling some of the Mississippian species of *Productus*.

Occurrence.—Especially abundant in the Productella zonule at Rudd. The same, or closely related form, is common in the Eatonia zonule in the Baumgardner phase and in the Cyrtoceras zonule at Nora Springs.

Holotype.—No. 130; *Paratypes.*—Nos. 390, 299, 232, C.H. B., No. 1493, U.C.M., and No. 71365, U.S.N.M.

CAMAROPHORIA PAUPERA BELANSKI

Plate XIV, Figs. 18-26.

Camarophoria paupera Belanski. Bull. State Univ. Iowa Studies in Nat. Hist. vol. XII, No. 7. p. 27, Pl. IV, figs. 6-14. 1928.

Description.—Shell small, subtriangular to sub-pentagonal in outline. Dimensions of the holotype and a paratype: length 6.3 and 7. mm.; width 7.6 and 8.5 mm.; height 5 and 6.2 mm.

Pedicle valve moderately convex, with the greatest curvature slightly posterior to the midlength. Surface arching gently toward the anterior and antero-lateral margins for about two-thirds the length of the shell, then is abruptly deflected; gently and uniformly arched to the postero-lateral and cardinal margins. Beak conspicuous, acutely pointed, incurved. Sinus originates near the midlength as a rounded depression which broadens and deepens anteriorly and is produced in a broad subquadrate lingual extension which is nearly at right angles to the plane of the valve. Anteriorly it bears one low subangular plication; this may bifurcate on very large specimens and from two fainter ones; the sinuses of small specimens may be nonplicate. Each lateral slope bears two, or rarely three, subangular plications which at the front of the shell are strongly elevated,—the central pair in some cases as much as 2 mm. Internally, a strong median septum reaches nearly to the

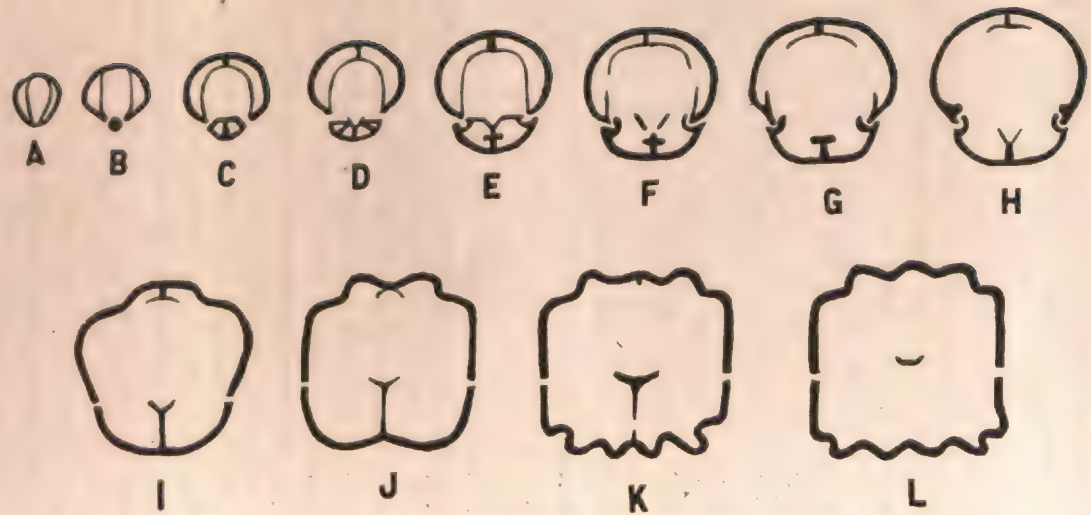

Fig. 2.—A series of 12 cross-sections of the rostral portion of the shell of *Camarophoria paupera*, showing the dental lamellae and spondylium of the pedicle valve; and the median septum, hinge plate and cruralium of the brachial valve. x6.

front, and supports the spondylium for more than half the distance.

Brachial valve slightly less convex than the pedicle, with its greatest curvature in the umbonal region. The surface arches gently to the postero-lateral and cardinal margins but is abruptly deflected near the anterior margin with the surface between the plications produced in sharp, cuneate, lingual extensions. Fold originates near the mid-length, where it is abruptly defined by angular grooves, although at the anterior margin its crest is at about the general level of the valve. Mesially it bears a shallow, subangular furrow which may reach the umbo. Each lateral slope bears two sharply angular plications which are separated by deep subangular furrows; plications lacking on the posterior half of the valve. Internally, a stout median septum supports the hinge plate and cruralium and reaches nearly to the front of the valve. The cruralium is heavy and extends forward more than two-thirds of the distance to the front of the shell, its anterior portion strongly elevated. Surface of both valves marked by faint concentric growth wrinkles which are especially prominent upon the reflected anterior portions.

Remarks.—In the reflected anterior margins of its valves and in its angular and strongly elevated plications, *Camarophoria paupera* differs markedly from any other Devonian member of the genus. *C. swallovi* (Branson) has reflected margins but in every case they are more rounded, and its plications are low and rounded and much more numerous than in *C. paupera.*

Occurrence.—Confined to the Camarophoria zonule, being especially common at Nora Springs. It has been found also at Rockford, as well as in the Sherman Bluff phase.

Holotype.—No. 10; *Paratypes.*—Nos. 15, 16, 18, 20, C.H. B., No. 1494, U.C.M., and No. 71027, U.S.N.M.

EATONIA GREGARIA N. SP.

Plate XV, Figs. 7-17.

Description.—Shell wider than long, with greatest width, at, or slightly posterior to the midlength. Dimensions of the holotype: length 12 mm.; width 15 mm.; thickness 9.5 mm.

Pedicle valve strongly convex with the greatest convexity posterior to the midlength; surface arching strongly from the umbonal region to the anterior and lateral margins, and sloping rather sharply to the cardinal margins. Beak small, rather blunt, incurved, pierced just below its extremity by a small circular foramen. Sinus originates slightly posterior to the middle of the valve; it forms a broad shallow depression which is well defined anteriorly and produced into a long lingual extension lying at a high angle to the plane of the valve. Anteriorly the sinus bears from 3 to 5 low, subangular plications, the central one originating near the midlength, those on the sides appearing progressively farther anteriorly, the increase being by intercalation. Each lateral slope bears from 1 to 3 similar plications, those on either side of the sinus being much the strongest. Internally, the hinge teeth are strongly developed but are not supported by dental lamellæ.

Brachial valve nearly as convex as the pedicle with the greatest curvature posterior to the midlength. Surface arching gently from the beak to the anterior margin, and sloping rather sharply to the lateral and cardinal margins. Beak small and incurved, concealed by that of the pedicle valve. Fold broad, flattened, originating about one-third the distance anterior to the beak and rather strongly elevated anteriorly; in specimens of average size it is divided by a shallow groove originating near the middle of the valve, but in larger specimens it may have as many as five plications. Each lateral slope bears 2 to 3 rounded plications that originate near the midlength. Internally, a very

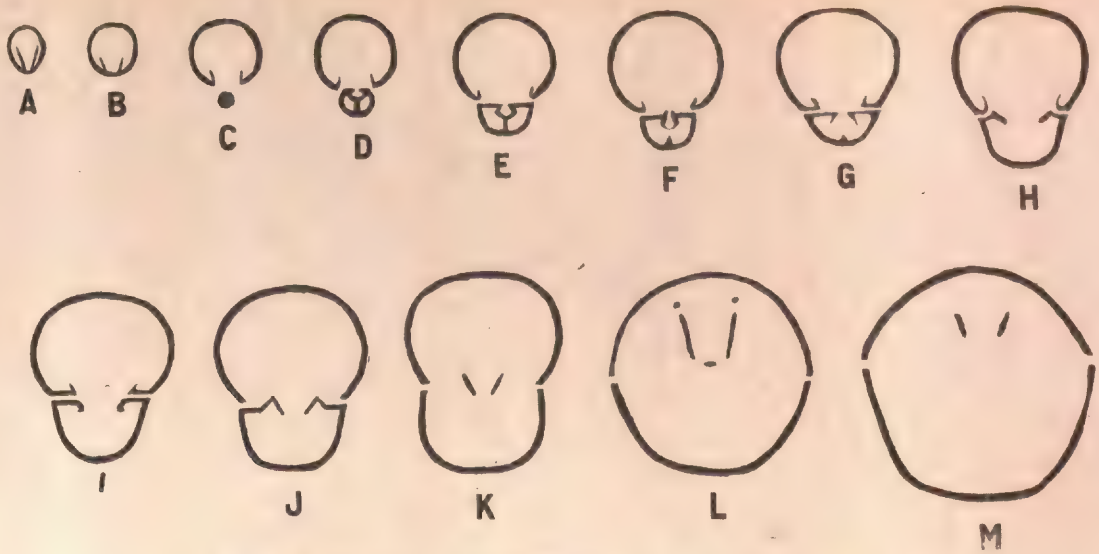

Fig. 3.—A series of 13 cross sections from the rostral portion of the shell of *Eatonia gregaria*, showing the unsupported teeth of the pedicle valve, and the median septum, crural cavity and crura of the brachial valve. x4.

short median septum is developed; the hingeplate is short and divided by a narrow crural cavity and is supported by the median septum for a very short distance.

Surface marked by very fine concentric growth lines. On the holotype there appear to be interrupted radiating striæ. These have been observed on no other specimen and their appearance here may be due to weathering.

Remarks.—This species apparently has no related form in the Iowa Devonian. Externally it bears considerable resemblance to *Eatonia variabilis* Whiteaves from the Hay River district of Canada. The internal character of the Canadian form, however, indicates a different genus from that to which it was originally referred.

Occurrence.—Particularly abundant in the Eatonia zonule in the Baumgardner phase where dozens of specimens may be obtained.

Holotype.—No. 1323; *Paratype.*—Nos. 1193, 1322, C.H.B. No. 71039, U.S.N.M., and No. 1441, U.C.M.

HYPOTHYRIDINA MAGISTER N. SP.

Plate XV, Figs. 1-6.

Description.—Shell subpentagonal to subcircular in outline, nearly as long as wide, with the greatest width at, or slightly posterior to the midlength. Dimensions of the (exfoliated) holotype: width 33 mm.; length 31 mm.; thickness 26 mm.

Pedicle valve depressed convex, with the greatest convexity slightly anterior to the beak; its surface arches gently from the beak to the antero-lateral margins but slopes gently to the lateral margins, slightly depressed near the posterior margins. Beak small, pointed, strongly incurved, pierced at its extremity by a small circular foramen beneath which is a triangular deltidial plate; these are best seen in sections. Sinus originates about one-fourth the distance anterior to the beak; broad and poorly defined on the central portion of the valve; anteriorly produced into a broad, subquadrate lingual extension at nearly right

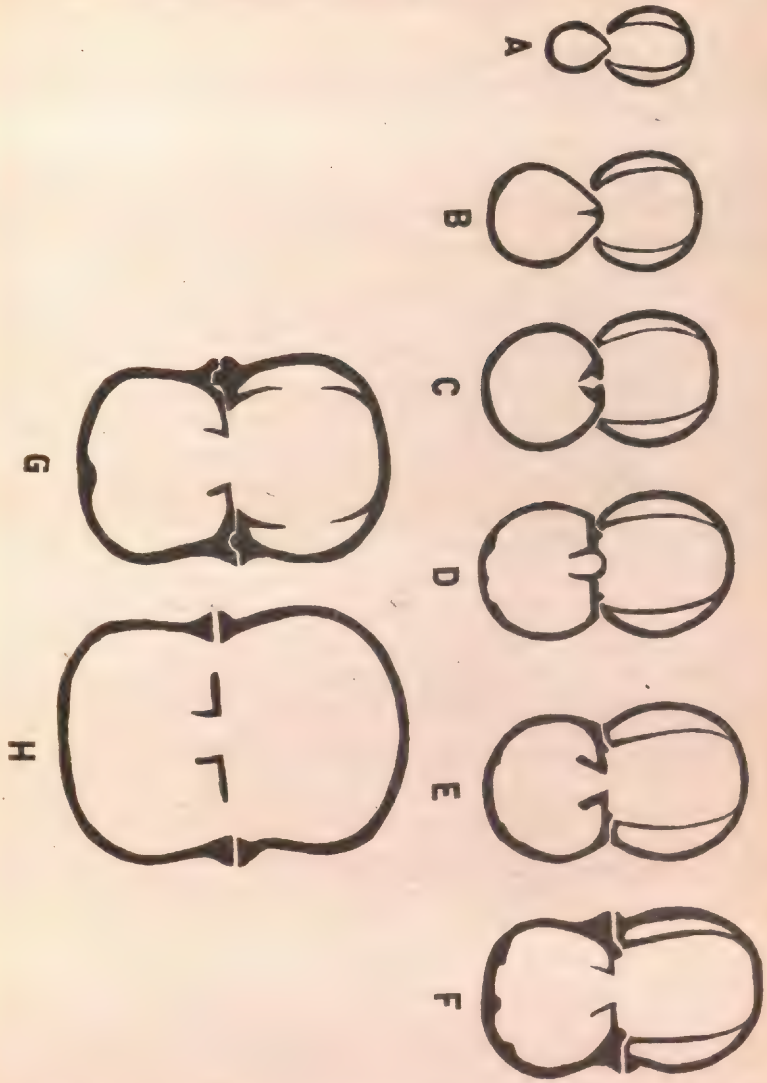

Fig. 4.—A series of 8 cross-sections from the rostral portion of the shell of *Hypothyridina magister*, showing the teeth and dental lamellae of the pedicle valve, and the crural cavity and crura of the brachial valve. Note the absence of a median septum in the brachial valve. x2.

angles to the plane of the valve. Surface marked by 22 to 26 strong, subangular plications which are faint or lacking on the posterior portion of the valve; of these 8 to 9 are on each lateral slope and 6 to 8 in the sinus; those on the slopes apparently are simple, whereas a few of those in the sinus bifurcate. Internally, the hinge teeth are strong and are supported by short, thin dental lamellæ.

Brachial valve more convex than the pedicle, with the greatest convexity posterior to the midlength; its surface curves sharply to the lateral and cardinal margins. Beak small, pointed, incurved, largely concealed beneath that of the pedicle valve. Fold broad, flattened, rather low; originating slightly posterior to the midlength, where it is poorly defined; elevated anteriorly with its lateral margins sloping sharply down to the shell surface. Plications correspond in number and size to those of the pedicle valve. Internally the hinge plate is divided by a narrow, linear crural cavity: the rudimentary median septum does not support the hinge plate since it is elevated but little above the shell floor. Surface marked by fine, rather sharp, concentric growth lines which arch slightly backward over the plications.

Remarks.—This species apparently has no close relative in the Iowa Devonian. The only other member of this genus which is known to occur in Iowa is the Upper Davenport form, referred to *Hypothyridina cuboides* (Sowerby). This is much smaller, more quadrate in outline and with more numerous and much weaker plications.

Occurrence.—Confined to the Lepidocentrus zone, and particularly common in the Camarophoria zonule at Nora Springs. Due to its large size and fragile shell it is generally found as fragmentary valves or occasional complete but crushed specimens.

Holotype.—No. 935; *Paratypes.*—Nos. 1255, 1711, 462, C.H.B., No. 71044, U.S.N.M., and No. 1492, U.C.M.

SPIRIFER CARDINALIS N. SP.

Plate XVI, Figs. 23-30.

Description.—Shell semi-circular to subtriangular in outline, wider than long, with the greatest width along the hinge line. Cardinal extremities sharply angular in immature specimens, becoming relatively more obtuse with advancing age. Dimensions of the holotype and of a paratype: length 14.5 and 15 mm.; width 18.7 and 24. 5 mm.; height 11.4 and 12 mm.

Pedicle valve strongly convex with the greatest convexity anterior to the middle. Surface arching gently from the beak to the anterior margin, more strongly to the anterolateral margins, and sharply to the cardinal margins; the cardinal extremities slightly produced and bearing shallow sulci slightly anterior to the cardinal margins. The sinus originates near the beak as a subangular depression which becomes broader and deeper anteriorly, its floor flattened at the front of the shell; normally it is non-plicate but rarely bears a faint plication in the bottom. Beak of moderate size, obtusely pointed slightly incurved. Cardinal area triangular, three times as wide as high, gently concave, its lower portion nearly vertical, marked by fine vertical striae and by transverse wrinkles. Lateral margins of the area sharply defined and subparallel with the cardinal margin for about one-third their length. Delthyrium nearly twice as high as wide, with no apical callosity or deltidial plate. Internally, the hinge teeth are strong and are supported by stout lamallae which extend about one-third the distance to the front of the valve.

Brachial valve most convex just anterior to the beak, its surface arching gently to the anterior and lateral margins; cardinal extremities slightly depressed and marked by sulci similar to those of the pedicle valve. The fold originates as a rounded elevation near the beak becoming moderately elevated and flattened anteriorly, well defined for its entire length. Beak small, blunt, strongly incurved. Cardinal area narrow, divided by a triangular delthyrium.

Plications similar to those of the pedicle valve. Internally, the dental sockets are strong and moderately divergent. The muscular area is small and weak.

Surface of both valves marked by sharp, concentric, lamellose growth lines which average about 3 in the space of 1 mm. These are very conspicuous on the fold and sinus.

Remarks.—In general shape and surface markings this species suggests *Spirifer inutilis* Hall of the Cedar Valley; but that species has a stout deltidial plate, whereas in *S. cardinalis* the delthyrium is open. This feature points to generic rather than specific difference between the two forms.

Occurrence.—*S. cardinalis* is particularly common in the Eatonia zonule, from which the types are taken. A form with more rounded cardinal extremities is equally common in the Camarophoria zonule at Nora Springs. Apparently varietal forms are more or less common in several other zonules of the Shellrock.

Holotype.—No. 969; *Paratypes.*—Nos. 315, 370, C.H.B., No. 71364, U.S.N.M., and No. 1495, U.C.M.

TRIGONOTRETA SHELLROCKENSIS N. SP.

Plate XVI, Figs. 11-18.

Description.—Shell semicircular in outline with greatest width at, or just anterior to the hinge line; cardinal extremities angular or very slightly rounded. Dimensions of the holotype and of a paratype: width 17 and 17 mm.; length 13 and 12 mm.; height 12 and 13 mm.; height of cardinal area 8 and 7.5 mm.

Pedicle valve subpyramidal, the surface sloping sharply from the beak to the anterior and lateral margins. Sinus originates near the beak; well defined, produced into a short, rounded lingual extension. Bottom of the sinus gently rounded, bearing 5 to 7 strong, rounded plications, of which only the outer 1 or 2 are simple, the others arising by repeated bifurcation of the central one. Each lateral slope bears 15 to 17 strong, rounded, simple plications,

those bounding the sinus being coarser than the others, those toward the extremities are fine and somewhat flexuous. Beak small, pointed, slightly incurved, projecting well beyond the cardinal line. Cardinal area moderately curved and generally distorted, its width half again its height; its lower portion nearly vertical to the plane of the valve or slightly inclined anteriorly; lateral margins well defined; surface marked by fine vertical striae and fine transverse growth wrinkles. Delthyrium twice as high as wide. Internally, the hinge teeth are supported by short, moderately divergent dental lamellae. The apical sixth of the delthyrium is filled by a stout, convex deltidial plate.

Brachial valve depressed convex, most prominent in the middle; its surface arching gently from the beak to the anterior and lateral margins and slightly flattened near the cardinal extremities. Fold originates near the beak and is bounded for the most of its length by a pair of furrows which are somewhat deeper than those between the plications; its top is gently rounded. Beak small, inconspicuous; cardinal area very narrow, divided by a rather broad delthyrium.

Surface marked by fine concentric growth lines which impart a faintly crenulate appearance to the plications. Some specimens show one or more stronger constrictions of growth, however, this feature is uncommon.

Remarks.—This species is intimately related to the genotype, *Trigonotreta aperturatus* (Schlotheim), from the German Devonian. The chief features distinguishing the two are the uniformly larger size of the German species, its more erect cardinal area, and the proportionately greater number of plications in the fold and sinus. As many as 17 plications have been counted on the fold of *T. aperturatus* whereas the greatest number noted on that of *T. shellrockensis* is 9.

Judging from Whiteaves' description (Cont. Can. Pal. Vol. 1, pt. 3, pp. 222-223, 1891), it appears that *T. shellrockensis* rather than *T. cyrtinaformis* (H. & W.) is the *Trigonotreta* found in the Devonian of the Hay River district of

Canada. *T. cyrtinaformis* is uniformly smaller than the present species and has nearly double the number of plications on each valve. In true *T. cytinaformis* the fold and sinus are very indefinitely bounded, whereas on *T. shellrockensis* both are sharply defined. Of the different species of *Trigonotreta* of the overlying Hackberry stage, the one most closely related to *T. shellrockensis* is *T. Foliose latimarginata* (F.&F.) which can readily be distinguished by its more elongate extremities and also by its high, nearly flat, anteriorly-inclined cardinal area.

Occurrence.—With the exception of the zonules of the Paracyclas zone, *T. shellrockensis* occurs more or less commonly in every member of the Shellrock. It is especially abundant in the Trigonotreta zone, particularly in the Bactrocrinus and Cyrtoceras zonules. The types are from the Bactrocrinus zonule.

Holotype. — No. 720; *Allotype.* — No. 728; *Paratypes.* — Nos. 2242, 1799, C.H.B., and No. 71028, U.S.N.M.

PLATYRACHELLA BALLARDI N. SP.

Plate XVI, Figs. 1-10.

Description.—Shell wider than long, with greatest width slightly anterior to the hinge line; the cardinal extremities gently rounded. Dimensions of the holotype and of a paratype: width 18 and 22.5 mm.; length 11 and 14 mm.; height 13 and 14 mm.

Pedicle valve subpyramidal, its surface sloping with a slight curvature from the beak to the anterior and lateral margins. Sinus well defined, non-plicate, with broadly flattened floor; it originates near the beak and is produced into a short rounded or subquadrate lingual extension. Each lateral slope bears 10 to 12, low, rounded, simple plications; those near the extremities being smaller than the others. Beak prominent, pointed, very slightly incurved. Cardinal area moderately high, flat or very gently concave; in some specimens it is inclined anteriorly at an angle of 75 degrees to the plane of the valve; in other speci-

mens it is posteriorly inclined at an angle of as much as 120 degrees. Surface of the area marked by fine vertical striae. Delthyrium nearly twice as high as wide. Internally, the teeth are moderately developed and are supported by stout lamellae which extend anteriorly for nearly half the length of the valve. A stout transversely-convex delthyrial plate occupies the apical fourth of the delthyrium.

Brachial valve depressed convex, with the greatest convexity posterior to the middle; its surface curving gently to the anterior and to the lateral margins; in some cases flattened or depressed near the extremities. Fold originates near the beak; it is well defined throughout its length and moderately elevated anteriorly where its top is broadly flattened. Plications similar to those of the pedicle valve. Beak small, blunt, strongly incurved; cardinal area narrow; delthyrium broad. Internally, the dental sockets are prominent and strongly divergent. Muscular scars weak and poorly defined.

Surface marked by uniformly distributed, fine, radiating striae each of which bears a row of minute granules. These striae are very prominent in the furrows and upon the fold and sinus; those of the fold and sinus less granulose than those of the lateral slopes. Heavy growth constrictions cross the plications and well preserved specimens show much finer concentric lines.

Remarks.—The species is closely related to the genotype, *Platyrachella macbridei* (Calvin), differing largely in its uniformly smaller size and much coarser striae and granules,—*P. macbridei* having more than twice as many striae on each plication as has *P. ballardi.* In the former the lingual extension is rather long and rounded whereas in the latter it is short and subquadrate. In general shape *P. ballardi* resembles *Spirifer asper* Hall of the Cedar Valley, in which, however, the delthyrial plate is very different. Specific name in honor of Mr. H. G. Ballard of Rockford, Iowa.

Occurrence.—Confined to the Platyrachella zone; especially abundant in the Schuchertella zonule at Rockford, the types

being from this member. Specimens nearly twice the size of the Rockford forms are found in the central (Syringopora) member of this zone northwest of Nora Springs.

Holotype.—No. 277; *Paratypes.*—No. 702, 1042, 2185, C. H.B., and No. 71035, U.S.N.M.

PLATYRACHELLA ULSTERENSIS N. SP.

Plate XVII, Figs. 1-8.

Description.—Shell large, wider than long, with the greatest width along the hinge line; cardinal extremities obtusely to sharply angular. Dimensions of the holotype: width 58 mm.; length 32 mm.; thickness 30 mm.; height of cardinal area 12 mm.

Pedicle valve strongly convex, deepest umbonally; its surface arching rather sharply to the anterior margin, more gently to the antero-lateral and lateral margins, in some cases slightly flattened near the extremities. Sinus non-plicate, originating near the beak; shallow, rounded or broadly flattened but well defined, with a short, broadly rounded lingual extension, which as a rule is steeply inclined. Each lateral slope bears from 15 to 17, simple, broad, rounded plications which become progressively fainter toward the extremities, the last 4 or 5 being somewhat flexuous and those bounding the sinus are broader and flatter than the others. Beak large, obtuse, moderately incurved, projecting considerably beyond the cardinal line. Cardinal area large and rather high, its lower half nearly flat and inclined posteriorly, its upper portion increasingly concave; lateral margins well defined and in senile specimens subparallel with the cardinal margins near the extremities. Surface marked by fine vertical striae and by transverse lines and constrictions of growth. Delthyrium large, nearly as wide as high, its apical fifth filled by a stout, transversely-convex delthyrial plate. Internally, the teeth are prominent and are supported by stout, divergent dental lamellae, which continue anteriorly for nearly one-third the length. In well

preserved casts a thin, sharp, rather low median septum extends from the beak nearly to the midlength.

Brachial valve nearly as convex as the pedicle, with the greatest depth near the middle; its surface arches gently to the anterior, and sloping gently to the lateral and anterolateral margins, with the extremities depressed and in some cases flattened. Fold non-plicate, sharply defined to the beak; at first scarcely elevated but becoming more so anteriorly, where it is flattened or gently rounded. Plications correspond to those of the pedicle valve. Beak small, blunt, moderately incurved; cardinal area long and narrow; delthyrium broad. Internally, the socket plates are rather prominent and strongly divergent; the muscular area weak and poorly defined.

Surface marked by fine, flexuous rows of elongate granules which are highest at their anterior ends. They are most prominent on the fold and sinus and in the furrows, there being from 4 to 6 rows in the space of 1 mm. Crossing these rows are numerous growth constrictions, which are stronger and more numerous near the front of the shell.

Remarks.—*Platyrachella ulsterensis* closely resembles the form of *P. iowensis* (Owen) which is found near Independence, Iowa, but is distinguished by its smaller size, proportionately higher cardinal area, flattened fold and sinus, and flatter plications, and further by the absence of produced extremities. *P. ulsterensis* has a median septum in the pedicle valve; a feature never found in *P. iowensis*. Still other differences are found in the character of the finer surface markings of the two species.

Occurrence.—Abundant in the Ulsterensis zonule where it occurs as casts; more or less common throughout the Schizophoria zone in western Floyd County. Casts, apparently of this species, also occur in the shaly upper portion of the Platyrachella zone at Rockford. The types are from the Crania zonule.

Holotype.—No. 1905; *Paratypes.*—No. 647, C.H.B., and No. 71034, U.S.N.M.

PLATE XII

FIGURES PAGE

1. *Cylindrophyllum floydense* n. sp. ---------- 176
Part of the upper surface of a large colony showing the irregular mode of growth. (2001 C.H.B.) x 1.

1. *Prismatophyllum oweni* n. sp. ---------- 174
Upper surface showing the well defined calyces and deep central pits. (471 C.H.B.) x 1.

3. *Pachyphyllum websteri* n. sp. ---------- 171
Upper surface of small corallum showing the short, closely crowded "rings", (2176 C.H.B.) x 1.

4— 6. *Crania millepunctata* n. sp. ---------- 186

4. Brachial view of an imperfect specimen showing the strong radiating striae and their irregular arrangement. (60 C.H.B.) x 2.

5. Interior of a large and nearly complete brachial valve showing the muscle scars. (62 C.H.B.) x 2.

6. A portion of the same enlarged to show the abundant punctae. x 5.

PLATE XIII

1—16. *Lepidocentrus ? thomasi* n. sp. ---------- 181

1—13. Interambulacral plates showing primary tubercle, basal terrace, adoral bevel, etc. Plates from both halves of the interambulacrum are shown. (1808 C.H.B.) x 3.

13—15. Lower, upper and lateral views of an ambulacral plate showing pore-pair, imbricating process, etc. (68 C.H. B.) x 4.

16. A portion of a primary spine showing the short base and strong vertical striae. (68-D C.H.B.) x10.

17—28. *Devonocidaris jacksoni* Thomas ---------- 183

17—21. Five typical interambulacral plates showing strong basal terraces and weakly developed secondary tubercles. (3722 C.H.B.) x 3.)

22—27. Several ambulacral plates showing primary tubercles, horizontically arranged pore-pair, peripodium, etc. (3692 C.H.B.) x 5.

28. A portion of a primary spine showing the fine vertical striae, rounded annulus, etc. (3692 C.H.B.) x 10.

29—34. *Devonocidaris primaevus* n. sp. ---------- 184

29. A typical primary spine showing the strong vertical striae. (674 A C.H.B.) x 10.

FIGURES PAGE

30—34. Five interambulacral plates. Note weakly developed basal terraces of the primary tubercles and numerous secondary tubercles which in Figs. 30 and 34 are surrounded by narrow basal terraces. (1738 C.H.B.) x3.

35—37. *Bactrocrinus westoni* n. sp. ---------- 177

35. View of an incomplete specimen from the right anterior side showing the quadrangular radial. Dotted lines indicate the relationships of the basals and infrabasals. (1982 C.H.B.) x 1.

36—37. Right posterior and right anterior views of a specimen composed of basals and infrabasals. Note the elongate basals. (1675 C.H.B.) x2.

38—39. *Nassoviocrinus goldringae* n. sp. ---------- 179

38. Anterior view of a nearly complete specimen showing numerous primibrachs, isotomous arms, etc (1981 C.H.B.) x 1.

39. Anterior view of another nearly complete specimen showing the plates of the calyx. Note depressions at the angles of the calyx plates, pentagonal stem, etc. (1983 C.H.B.) x 1.

PLATE XIV

1— 7. *Schizophoria floydensis* n. sp. ---------- 187

1— 4. Pedicle, anterior, brachial and lateral views of a nearly complete specimen showing the high cardinal area. (500 C.H.B.) x 1.

5. Posterior view of a somewhat smaller specimen showing the size of the cardinal area. (276 C.H.B.) x1.

6. View of the interior of a rather large pedicle valve showing the muscle scars; the apparent emargination at the front of the shell is due to breakage. (444 C.H.B.) x 1.

7. Interior of an incomplete brachial valve showing the cardinal process, muscle scars, etc. (443 C.H.B.) x 1.

8—10. *Stropheodonta scottensis* n. sp. ---------- 190

8— 9. Pedicle and brachial views of a nearly perfect specimen of normal size. (300 C.H.B.) x 1.

10. Interior of a large incomplete brachial valve showing the strongly elevated muscle scars, crenulate hinge line, etc. (174 C.H.B.) x 1.

FIGURES PAGE

11—14. *Stropheodonta cicatricosa* n. sp. ---------- 189

11. Pedicle view of a nearly perfect specimen of normal size. (242 C.H.B.) x 1.

12. Brachial view of a somewhat smaller specimen. 356 C.H.B.) x 1.

13. Interior of a large pedicle valve showing the low median septum. (176 C.H.B.) x 1.

14. Interior of a small brachial valve showing the muscle scars, vascular sinuses, etc. (176-B C.H.B.) x1.

15-17. *Productella fragilis* n. sp. ---------- 192

Lateral, posterior and pedicle views of a nearly perfect specimen of normal size showing the widely separated spine bases and weak growth wrinkles. (130 C.H.B.) x 1.

PLATE XV

1— 6. *Hypothyridina magister* n. sp. ---------- 198

1— 4. Pedicle, anterior, brachial and lateral views of a specimen of normal size. (935 C.H.B.) x 1.

5— 6. Lateral and anterior views of a rather large specimen. (1255 C.H.B.) x 1.

7—17. *Eatonia gregaria* n. sp. ---------- 196

7— 9. Brachial, pedicle and anterior views of the holotype. (1323 C.H.B.) x 1.

10—12. Similar views of a smaller specimen with four plications on the fold. (1322 C.H.B.) x 1.

13—17. Posterior, anterior, pedicle and brachial views of a small specimen with but two plications on the fold. (1193 C.H.B.) x 1.

18-26. *Camarophoria puupera* Belanski ---------- 193

18—21. Brachial, anterior, pedicle and lateral views of a rather large specimen. (20 C.H.B.) x 2.

22—26. Brachial, posterior, anterior, lateral and pedicle views of a nearly perfect specimen of normal size. (10 C.H.B. x 2.

PLATE XVI

1—10. *Platyrachella ballardi* n. sp ---------- 204

1— 5. Pedicle, brachial, posterior, anterior and lateral views of a specimen of normal size. (277 C.H.B.) x 1.

FIGURES PAGE

6— 7. Posterior and anterior views of a slightly crushed specimen. (1042 C.H.B.) x 1.

8. A portion of the surface of the holotype enlarged to show the granulose stria, x5.

9. Interior of a rather large brachial valve. (262-A C.H.B.) x 1.

10. Cardinal area of a normal specimen enlarged to show the deltidial plate. (702 C.H.B.) x 3.

11—18. *Trigonotreta shellrockensis* n. sp. ---------- 202

11—14. Pedicle, anterior, posterior and lateral views of a specimen of normal size. (720 C.H.B.) x 1.

15—18. Anterior, posterior, lateral and pedicle views of a paratype. (1799 C.H.B.) x 1.

19—22. *Trigonotreta aperturatus* (Schlotheim) ----------
Anterior, posterior, brachial and lateral views of a rather small specimen from the Lower Devonian, Coblenz, Germany, Introduced for comparison with Figs. 11-18. (24740 W.M.) x 1.

23—30. *Spirifer cardinalis* n. sp. ---------- 201

23—26. Posterior, pedicle, brachial and anterior views of a rather large specimen. (315 C.H.B.) x 1.

27—29. Posterior, anterior, and pedicle views of a specimen of normal size. 969 C.H.B.) x1.

30. Pedicle view of a small specimen with a distinct fold in the sinus. (370 C.H.B.) x 1.

PLATE XVII

1— 8. *Platyrachella ulsterensis* n. sp. ---------- 206

1— 3. Posterior, pedicle and anterior views of a large specimen. (1905 C.H.B.) x 1.

4. Cardinal area of the same enlarged to show the deltidial plate. x 3.

5. Pedicle view of a crushed specimen showing the numerous growth wrinkles. (647 C.H.B.) x 1.

6. Portion of the surface of the specimen shown in figure 5 enlarged to show the surface markings. x 5.

7— 8. Pedicle and brachial views of an internal cast which illustrates the size and condition of most of the specimens.. Note low median septum of the pedicle valve. (499 C.H.B.) x 1.

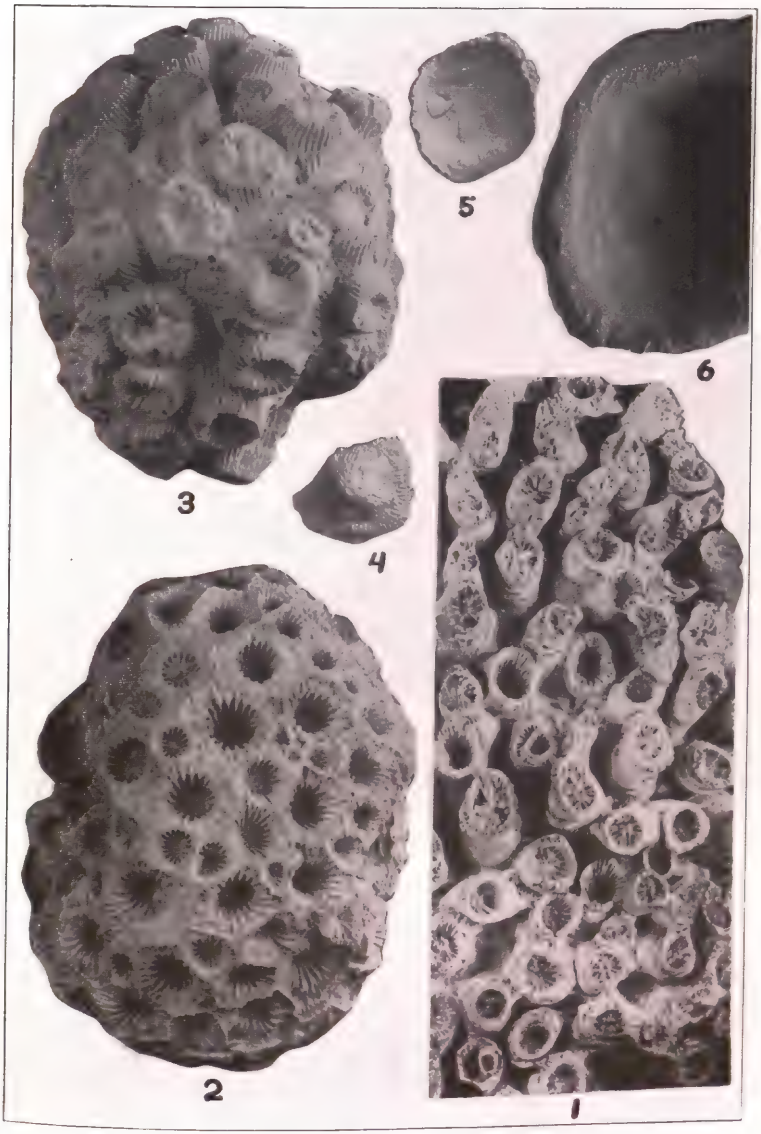

Plate XII

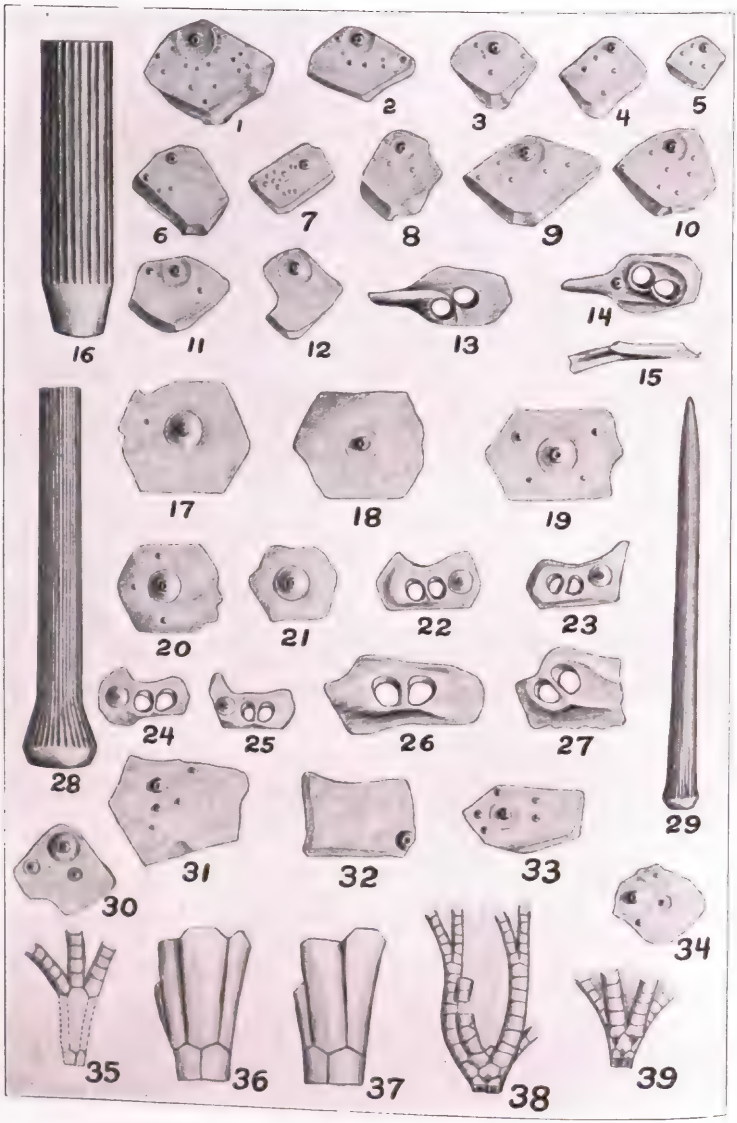
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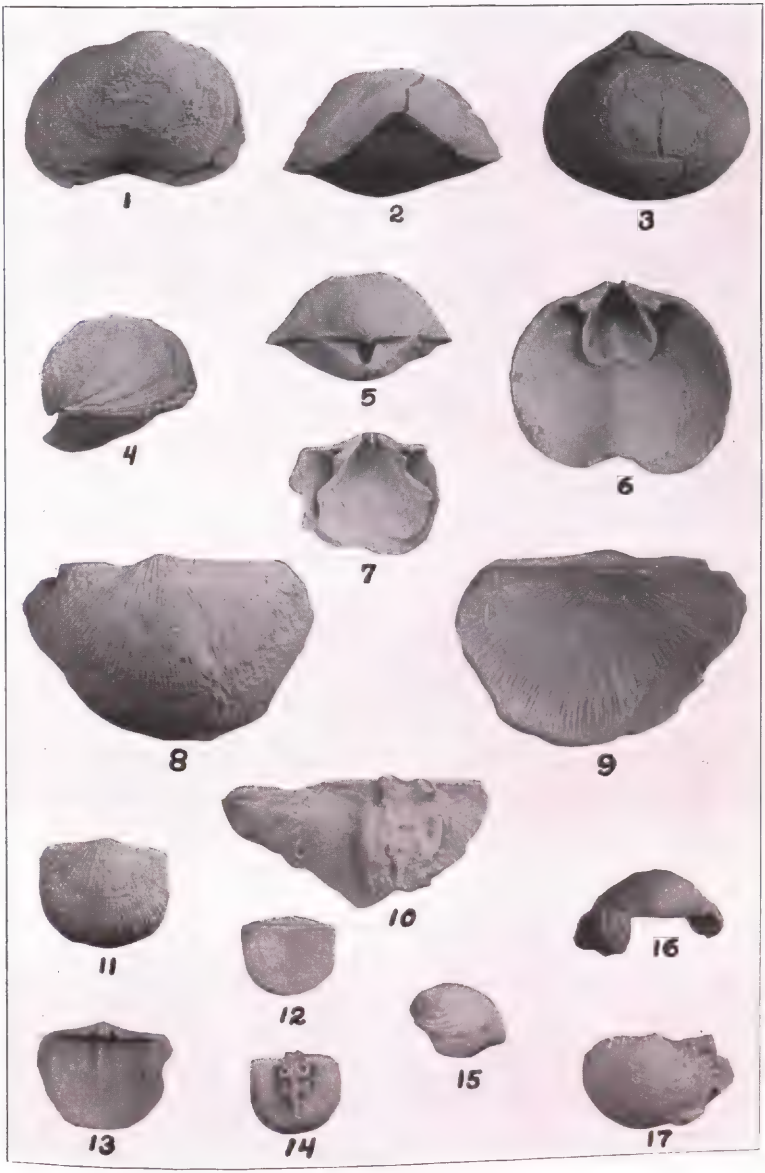
Plate XIII



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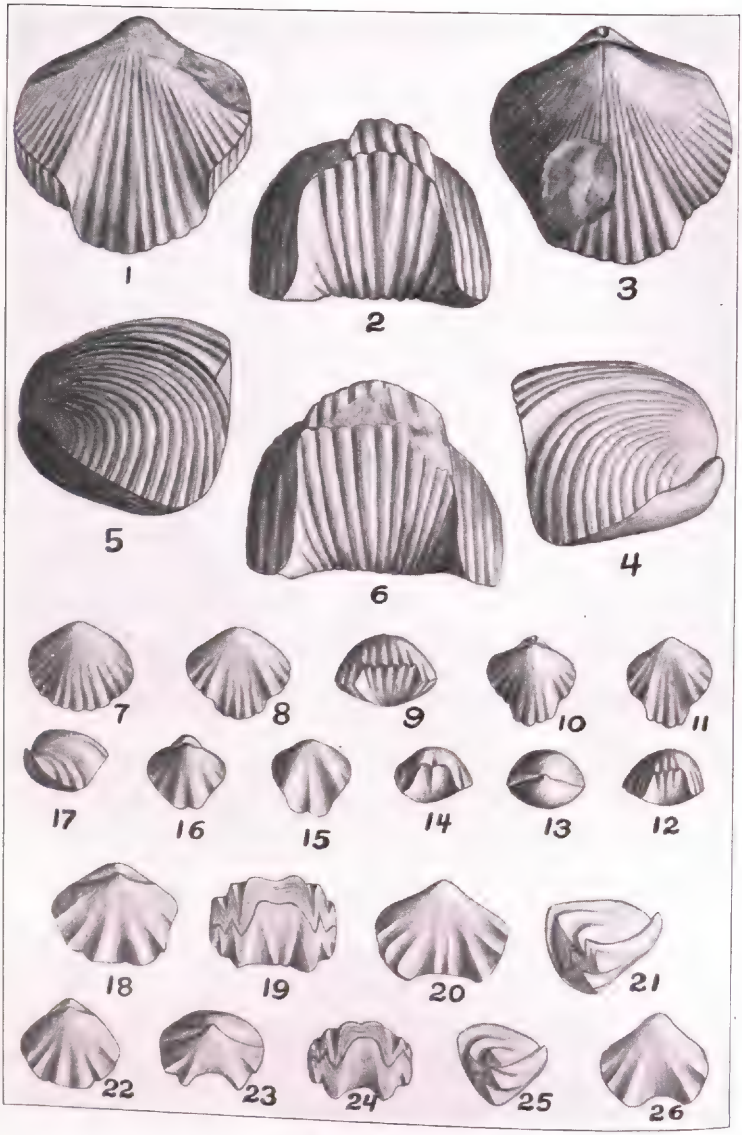

Plate XV

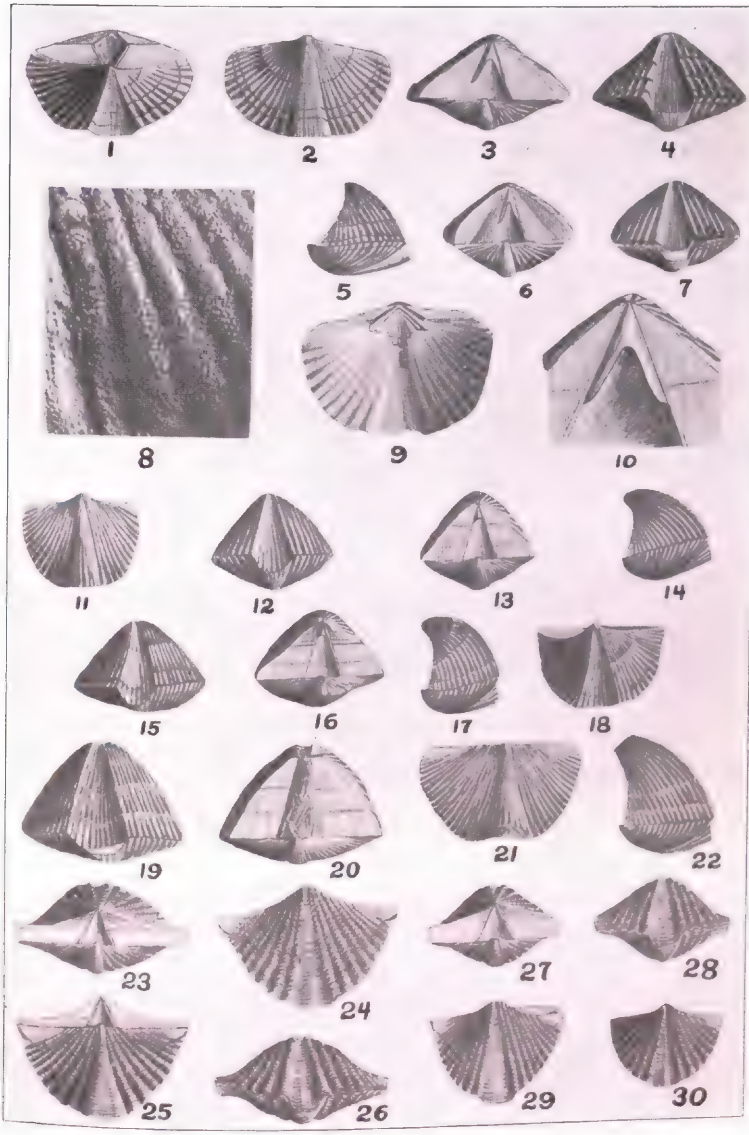
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Plate XVI

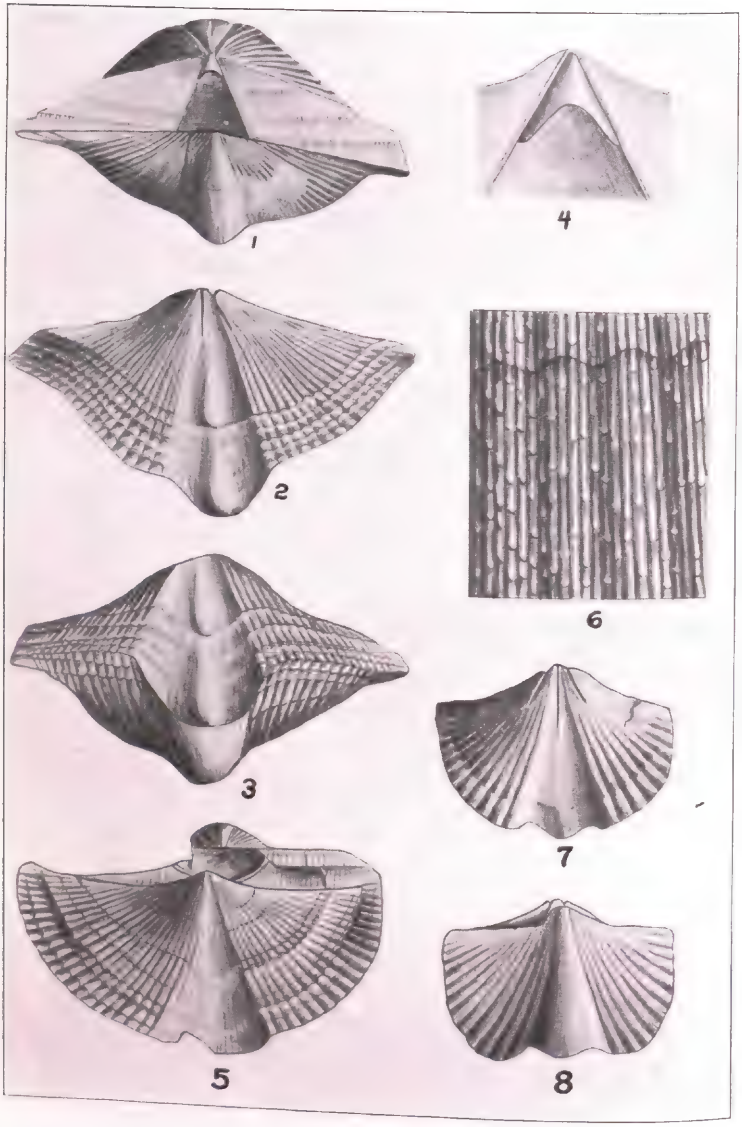

Plate XVII

SOME SPECIES OF SAXIFRAGA

BENJAMIN FRANKLIN BUSH

While looking through a package of unnamed specimens collected by Mr. Palmer in various places in Southern Missouri and Arkansas, I was somewhat surprised to find several collections of SAXIFRAGA, all of which appeared to be the same species, and one that I could not, after a thorough examination, refer to any described species with the aid of the references I had access to at the time.

In order to better inform myself as to the species of SAXIFRAGA likely to be found in Southern Missouri and Arkansas, I procured a copy of Dr. Johnson's Revision of the North American Species of the Section BORAPHILA of SAXIFRAGA, and an examination of this work has been very interesting.

The structural part of this revision, so far as I am able to judge, seems to be excellent, but the systematic part, that part dealing with the species themselves, their relationship and ranges, has the appearance of being the work of another person, in that it shows evidence of carelessness, many discrepancies, and a seeming lack of recognition of specific characters, which is not in agreement with the structural part.

In this Revision Johnson has described a number of new species, of which the northern and western may be quite valid, but those of the eastern and middle States appear to me not to be well founded, particularly those in the *pennsylvanica* group, to which reference more fully will be made further on in this paper.

Taking this Revision of Johnson's as it reads, one would think that the genus SAXIFRAGA was not at all, or but poorly represented in the middle and southern States, that is in Ohio, West Virginia, Indiana, Southern Illinois, Southern Missouri, Arkansas, Western Kentucky, Western Tennessee, Mississippi,

Georgia, Alabama, Louisiana, Oklahoma and Texas. Of this great region, Johnson does not cite a single species for Indiana, Southern Illinois, Western Kentucky, Western Tennessee, Georgia, Alabama, Arkansas, Oklahoma or Louisiana, and only cites one species each for Ohio, Southern Missouri and Texas, and two species for West Virginia.

This neglect of citing the complete range of the species by Johnson, when he had the specimens in hand for study at the time, can only be ascribed to carelessness, for he had all the SAXIFRAGA material from the Missouri Botanical Garden Herbarium, in which I am told there are a lot of specimens collected in Arkansas; and he had all the Deam's collection of SAXIFRAGA for study, more than fifty sheets, collected in Indiana, several from Ohio and Southern Illinois.

There are quite a number of trifling errors in the systematic portion of this Revision of Johnson's that could have been avoided, which mar the appearance of an otherwise admirable piece of work, such as misspellings, wrong dates, incorrect citations, as G. P. Ashcroft for G. B. Ashcroft, G. E. Fisher for G. L. Fisher, Munson, Indiana for Munson, Ohio, Nonquit, Massachusetts for Nonquitt, Massachusetts, Isle Royal for Isle Royale, rocky slopes of Pelican Lake, for rocky shores of Pelican Lake, June 13, 1893, for June 13, 1892, page 51, Sp. Pl. 399, 1752, for L. Sp. Pl. 399, 1753 and others.

To Chas. C. Deam, of Bluffton, Indiana, who has loaned me all of his material for study as well as a number of books on SAXIFRAGA, to Dr. C. O. Rosendahl, of the University of Minnesota, Dr. L. H. Pammel of the Iowa State College, Dr. H. Shantz, of the University of Illinois, Dr. P. C. Standley of the United States National Museum, Dr. W. J. Robbins, of the Missouri State University and Mr. E. J. Palmer, collector for Arnold Arboretum, I am under obligation for the loan of material to study, for all of which I now return thanks.

I am tolerably certain that I have evidences of some five or six species of SAXIFRAGA in Arkansas, Oklahoma and Louisiana, two or three of which are unique in appearance, but will defer publishing these until I can secure more material

for study and learn more about their ranges, but I am proposing one new species, which from an examination of a number of collections, appears to me to merit this distinction.

1. SAXIFRAGA VIRGINIENSIS Michx., Fl. Bor. Am. *1*: 269. 1803.

   S. vernalis Willd. Hort. Berol. 43. 1805.

   S. virginica Nutt. Gen. *1*: 285. 1818.

   S. verna Nutt.

   Dermasea pilosa b. *verna* Haw. Saxifr. 9. 1821.

   S. verna Hort. ex Steudel, Nomen. Bot. ed. 2, II, 524. 1841, according to Haworth, l. c. 9. 1821, but probably to be referred to *S. pilosa.*

   S. virginiensis Mich. Fl. Bor. Am.*1*: 1803, according to Haworth, l. c. 9. 1821.

   S. vernalis Sternberg, Rev. 8. 1910, according to Haworth, l. c. 9. 1821.

   S. vernalis Sternberg, Rev. 8. 1910.

   Micranthes virginiensis (Michx.) Small, Fl. S.E.U.S. 501. 1903.

Under *Dermasea pilosa,* b *verna,* Haworth says "foliis cuneato-ovalibus argute serratis petiolo brevioribus, caule paniculato, floribus subglomeratis," which agrees quite well with the eastern plant that I take to be Michaux's *Saxifraga virginiensis.*

New Brunswick to Minnesota, Georgia and Tennessee, according to Britton in Manual, l. c. 479, but the Georgia and Tennessee references may refer to the form that I take to be *S. pilosa* Haworth.

New Brunswick to Minnesota, Georgia and Tennessee, Britton & Brown in Illustrated Flora, l. c. 218, being the same statement as that of Britton's Manual.

New Brunswick and Quebec to Minnesota, Missouri and Tennessee, Robinson and Fernald in Manual, l. c. 446, but the Missouri and Tennessee references must apply to *S. pilosa* Haw.

New Brunswick and Minnesota, Georgia and Tennessee. Small in Flora, l. c. 503, being the same statement as that in Britton's Manual.

New Brunswick to Minnesota, Georgia and Tennessee. Small in North American Flora, l. c. 141, being a repetition of the range as given in Britton's Manual.

New Brunswick to Quebec, Minnesota and Missouri, Johnson in Revision, l. c. 33, but the Missouri reference must apply to *S. pilosa* Haworth.

New Brunswick to Minnesota and Virginia, and probably extending further, but the exact distribution not known now.

Silica, Missouri, Bush, l. c. 139, based on specimens collected by Eggert, Russell and Trelease, but these are almost certainly *S. pilosa* Haworth.

Saint Louis, Eggert, l. c. 14, but the specimens were collected in Jefferson County, Missouri, without doubt and are very likely what I take to be *S. pilosa* Haworth.

Plants 2:5 to 3 dm. tall, with more than one-half of the stems consisting of the widely branched inflorescence, usually with several or many flowering branches from the base of the plants; petals thrice the length of the sepals, oblong-spatulate, acute, pure white; sepals broadly lanceolate, acute; follicles recurved at the upper ends and widely spreading. May.

A very variable species, presenting several distinct-looking forms, some of which may be worthy of specific rank when studied more.

Haworth (6) has described several species and varieties under the generic name *Dermasea*, of which *D. pilosa* and *D. elongata* seem to me to be the same, and represent a good distinct species.

There are two very different-looking plants among the specimens examined by me, which may or may not be the same species; the first has the flowers racemosely arranged, and this form I take to be Haworth's *S. pilosa;* the other has the flowers cymosely arranged, the two forms looking quite different in fruit, but otherwise appearing superficially alike: this latter form I take to be the true *S. virginiensis* of Michaux.

Johnson (7) does not cite any collection of *virginiensis* from West or South of Pennsylvania, or West or South of Michigan, being seemingly inclined to regard the western and southern plants as different from *virginiensis*, in which opinion I am inclined to concur.

SPECIMENS EXAMINED: MAINE: Orono, *F. B. Briggs*, May, 1893, U.M. Herb.; Orono, *M. L. Fernald*, May 23, 1888, U.M. Herb. NEW HAMPSHIRE; Hanover, *C. H. Hitchcock*, May 5, 1883, U.M. Herb.; Hanover, *C. H. Hitchcock*, May 5, 1883, U.M. Herb. VERMONT: Rutland, *W. W. Eggleston*, April 27, May 8 and June 3, 1898, three collections on one sheet, U.I. Herb. MASSACHUSETTS: Nobscot Mill, *H. H. Bartlett* 141, May 28, 1905, D. Herb.; Lexington, *M. A. Day* and *M. L. Fernald* 91, May 8, 1902, D. Herb.; Arlington Heights, *F. P. Daniels*, May 1898, U. Mo. Herb.; Arlington, *Noland* and *L. H. Pammel*, May, 1886, I.S.C. Herb. 14016; Cambridge, *B. Fink*, May 6, 1895, I.S.C. Herb. 31441; Lexington, *M. A. Day* and *M. L. Fernald* 91, May 8, 1902, I.S.C. Herb. 22663; Medford *W. H. Manning* 849, May 30, 1880, U.M. Herb.; Beverly, *Sara M. Manning*, May 22, 1882, U.M. Herb.; Nonquitt, *E. P.*, May 1, 1889, U.M. Herb.; Lexington, *M. A. Day*, and *M. L. Fernald* 91, May 8, 1902, U.M. Herb.; Lexington, *M. A. Day* and *M. L. Fernald* 91, May 8, 1902, U.I. Herb.; Lexington, *M. A. Day* and *M. L. Fernald* 91, May 8, 1902, D. Herb.; Amherst, *E. L. Morris*, May 1889, U.M. Herb.; Amherst, *E. L. Morris*, May 1890, U.I. Herb.; Mount Warner, *G. C. Woolson*, April, 1870, U.I. Herb.; Stoughton, *S. F. Blake*, May, 1909, U.I. Herb.; Framingham, *H. H. Bartlett* 141, May 28, 1905, D. Herb. CONNECTICUT: Locality, collector and date not given, U.S.N. Herb. 777177. NEW YORK: Brooklyn, *Louisa M. Stables*, April 30, 1885, I.S.C. Herb. 76209; Ithaca, *W. C. Muenscher* and *A. R. Bechtel* 193, May 9, 1920, I.S.C. Herb. 112536; Ithaca, *H. E. Summers*, month and year not given, I.S.C. Herb. 74876; Ithaca, *H. E. Summers*, April 30, year not given, I.S.C. Herb. 74878; Ithaca, *H. E. Summers*, May 6, 1887, I.S.C. Herb. 74877; Ithaca, *H. E. Summers*, May 10, 1883, I.S.C. Herb. 73569; Ithaca, *E. J. Durand*, April 23, 1891,

U.M. Herb.; New Castle, collector not given, April 30, 1885, I.S.C. Herb.; East Greenwich, *A. Fitch,* month not given, 1861, U.M. Herb.; Troy, *R. H. Ward,* month not given, 1864, U.I. Herb.; Chestnut Hill, collector not given, May 2, 1891, U.I. Herb.; Canadian Lake, *E. J. Hill,* May 29, 1895, U.I. Herb.; Prince's Bay, Staten Island, *G. S. Hulst,* April 29, 1891, U.I. Herb., locality not given; *Hariting,* April 28, 1919, U.I. Herb.; locality, collector and date not given, U.I. Herb. NEW JERSEY: Woodbridge, *L. H. Lighthipe,* May, 1895, U.M. Herb.; Trenton, collector not given, April, 1888, U.I. Herb. DISTRICT OF COLUMBIA: Washington, *E. S. Steele,* April 11, 1897, U.M. Herb. MARYLAND: Hagerstown, *F. B. Trask,* April, 1925, I.S.C. Herb. 117762; Glen Echo, *L. H. Dewey,* 177, April 6, 1895, I.S.C. Herb. 48657; High Island, *E. L. Morris,* April, 1897, U.M. Herb. PENNSYLVANIA: Safe Harbor, *A. A. Heller* and *E. G. Halbach* 804, April 29, 1893, U.M. Herb.; Wissahickon, *J. B. Brinton,* May 13, 1883, I.S.C. Herb. 40060; Rawlinsville, *J. Galen,* date not given, U.M. Herb.; Lancaster, *J. K. Small,* April 12, 1889, U.M. Herb.; Allegheny County, *A. Koenig,* April 28, 1892, U.M. Herb.; Sayre *W. C. Barbour* 25, April 23, 1898, U.I. Herb. VIRGINIA: Rosslyn, *D. L. Topping,* April 13, 1895, U.M. Herb.; Rosslyn, *A. Chase* 2125, April 12, 1904, U.I. Herb.; Rosslyn, *A. Chase* 2125, April 12, 1904, U.I. Herb. ALABAMA: Locality, collector and date not given. U.I. Herb. CANADA: Cap a la Branche, Quebec, *M. Victorin* 4174, June, 1917, D. Herb.; Sparta, Ontario, *G. L. Fisher,* May 14, 1899, U.M. Herb.; Cap a la Branche, Quebec, *M. Victorin,* 4174, June 1917, D. Herb. MICHIGAN: Williamstown, *R. H. Ward,* July, 1856, U. I. Herb.; Isle Royale, Tobin's Harbor, *W. R. Wheeler* 716 and 722, August, 1900, U.M. Herb. OHIO: Newark, *Williamson,* April 19, 1897, D. Herb.; Lancaster, *A. Bigelow,* date not given, I.S.C. Herb. 14017; Hinckley, *J. R. Watson,* May, 1895, U.M. Herb.; Hinckley, *J. R. Watson,* June 1, 1894, U.M. Herb.; Akron, *K. O. Foltz,* April 22, 1888, U.M. Herb.; Newark, *E. B. Williamson,* April 18, 1897, D. Herb. INDIANA: Cannelton, *Deam* 27799, April 24, 1919, D. Herb.; Rockport, *Deam* 5534,

March 28, 1910, D. Herb; Cannelton, *Deam* 19362, May 5, 1916, D. Herb.; Spencer County, *Deam* 5534, March 28, 1910, D. Herb. MINNESOTA: Pelican Lake, *C. O. Rosendahl* 2381, August 30, 1909, U.M. Herb.; Two Harbors, *J. H. Sandberg*, May, 1891, U.M. Herb.; Two Harbors, *E. P. Sheldon*, June, 1893, U.M. Herb.; Flag Island, Lake of the Woods, *C. Mac Millan* and *E. P. Sheldon*, June, 1893, U.M. Herb. KENTUCKY: Dawson Springs, *E. J. Palmer* 22549, May 7, 1923, P. Herb.; Louisville, *O. E. Mueller*, April, year not given, U.M. Herb. TENNESSEE: Clarksville, *T. L. Andrews* 130, month not given, 1846, I.S.C. Herb. 32945; Lookout Mountain, *J. Schneck*, May 11, 1901, U.I. Herb. GEORGIA: Stone Mountain, *Biltmore Herb.* 204C, April 15, 1897, U.M. Herb. NO STATE GIVEN: No locality given, but probably Minnesota. *T. L. Andrews* 78, date not given, I.S.C. Herb. 81553.

A small part of the above cited specimens, especially the western and southern specimens, are probably to be referred to *S. pilosa*, but I have now no longer the opportunity to correct the determinations, the specimens having passed out of my hands before I concluded that the southern plant was *S. pilosa*.

2. SAXIFRAGA PILOSA Haworth, Saxifr. Enum. 8. 1821

S. virginiensis Pursh, Fl. Am. Sept. 310. 1814. not *S. virginiensis* Michaux, 1803.

Dermasea pilosa Haworth, Saxifr. 8. 1821.

Dermasea elongata Haworth, Saxifr. 9. 1821.

S. pilosa Banks; D. Don. frans. Linn Soc. *13*: 386. 1822, as synonym.

S. verna Hort. ex Steudel, Nomen. Bot. ed. 2. II, 524, as synonym of *Dermasea elongata* Haworth.

Of this form Haworth (5) says "Fclia obovata obtusissima dentata, basi saepe subcuneata, utrinque pilis brevibus erectus vestita, petiolis folia longioribus semi-teretiusculis. Pedunculi solitarii brevis, pilis horizontalibus minute vestiti, Facies sequentis, at paulo major, minute omnino pilosa (fructificatione excepta)." This clearly describes the western

and southern plants and appears to me to indicate a good species.

If these Saxifrages should be referred to the genus MICRANTHES, this species may properly be named MICRANTHES PILOSA (*Haw.*) n. comb.

SPECIMENS EXAMINED: MISSONRI: Jefferson County, *Eggert*, April 14, 1887, U.S.N.M. Herb. 518716; Mine La Motte, *E. J. Palmer* 30285, May 22, 1926, P. Herb.; Mine La Motte, *E. J. Palmer* 30285, May 22, 1926, P. Herb.; Jefferson County, *Eggert*, May 20, 1887, U. Mo. Herb. INDIANA: Fredonia, *Deam*, 44075, April 24, 1927, D. Herb.; Tobinsport, *Deam* 44182, May 4, 1927, D. Herb. KENTUCKY: Dawson Springs, *E. J. Palmer* 22549, May 7, 1923, P. Herb.; Louisville, *C. Mohr*, May 6, 1855, U.S.N.M. Herb. 772177, three plants on this sheet, the one marked 2. TENNESSEE: Madison County, *S. M. Bain*, April, 1822, U.S.N.M. Herb. 215157; Nashville, *A. Gattinger*, date not given, U.S.N.M. Herb. 777177; Erin, *E. J. Palmer* 17605, May 24, 1920, P. Herb.

3. SAXIFRAGA PALMERI n. sp.

Differing from *S. virginiensis* in being only 1.5 to 2.5 dm. tall; in having smaller, differently-shaped leaves, which are rounder at the base and entire or very obscurely sinuately-denticulate on the margins; in having an earlier flowering period; in having fewer flowering branches which are more strict, ascending or erect; fewer or usually no flowering branches from the base of the plants; branches of the inflorescerd consisting of less than one-half the height of the plant; petals broadly oblong, spatulate, broad and rounded at the obtuse ends, and green-lined at the broad scarious tips; follicles but little recurved, the beaks nearly erect or but little spreading. April.

This very distinct species of *Saxifraga* occurs in the mountainous regions about Van Buren, in western Arkansas (and the adjacent portions of Eastern Oklahoma) which is far from the known range of *S. virginiensis*, and somewhat removed from *S. pilosa* which has been collected in Kentucky,

Tennessee and in a few localities in extreme eastern Missouri.

For those who prefer the name MICRANTHES for these Saxifrages, I offer the name MICRANTHES PALMERI n. sp., for this plant.

Johnson (7) in his Revision does not cite any species of *Saxifraga* for Arkansas, but I have seen *S. pilosa* from about Pine Bluff, *S. Texana* from many localities in western Arkansas, and several other species that I have not yet determined.

SPECIMENS EXAMINED: ARKANSAS: Van Buren, *E. J. Palmer* 20731, April 10, 1922, P. Herb.; Van Buren, *E. J. Palmer* 29710, April 19, 1926, P. Herb.; Van Buren, *E. J. Palmer*, April 29, 1922, P. Herb.; Van Buren, *E. J. Palmer* 21020, April 30, 1922, P. Herb., all included in the TYPE; Jasper, Newton County, *E. J. Palmer* 27089, May 8, 1925, P. Herb.; Magazine Mountain, *E. J. Palmer* 24844, May 12, 1924, P. Herb.; Cove Creek Station, *E. J. Palmer* 29170, April 19, 1926, P. Herb.; Magazine Mountain, *E. J. Palmer* 24855a, May 12, 1924, P. Herb.; Magazine Mountain, *E. J. Palmer* 26932, April 26, P. Herb.

4. SAXIFRAGA MICRANTHIDIFOLIA (Haw.) B.S.P. Prel. Cat. N. Y. 17. 1888.

Robertsonia micranthidifolia Haw. Syn. Pl. Succ. 322. 1812.

Saxifraga erosa Pursh, Fl. Am. Sept. 311. 1814.
Saxifraga micranthifolia Steud. Nom. Bot. 736, 1821.
Aulaxis micranthifolia Haw. Saxifr. Enum. 47. 1821.
Saxifraga Wolleana T. & G. Fl. N. Am. *1*: 569. 1840.
Micranthes micranthidifolia (Haw.) Small, Fl. S.E. U.S. 501. 1903.

Pennsylvania to North Carolina, Britton in Manual, l. c. 479.

Pennsylvania to North Carolina and Tennessee, Robinson and Fernald in Manual, l. c. 446.

Pennsylvania to North Carolina and Tennessee, Small in Flora, l. c. 143.

Pennsylvania to North Carolina, Britton & Brown in Illustrated Flora, l. c. 219.

Pennsylvania to Georgia and Tennessee, Small in North American Flora, l. c. 143.

New Jersey to North Carolina, Tennessee and West Virginia, Johnson, l. c. 19.

SPECIMENS EXAMINED: TENNESSEE: Wolf Creek, *A. Ruth* 269, July, 1898, U.S.N.M. Herb. 345443; Roan Mountain, *Bitt. Herb.* 886c, July 15, 1903, U.S.N.M. Herb. 959296; Eastern Tennessee, *C. C. Parry,* month not given, 1870, U.S.N.M. Herb. 44118.

5. SAXIFRAGA TENNESSEENSIS Small, Bull. Torr. Club *23*: 364. 1896.

Micranthes tennesseensis Small, Flora S.E.U.S. 501. 1903.

Tennessee, Small in Flora, l. c. 503.

Tennessee and North Carolina, Johnson in Revision l. c. 32.

Tennessee, Small in North American Flora, l. c. 142.

SPECIMENS EXAMINED: TENNESSEE: Knox County, *A. Ruth* 982, April 20, 1897, I.S.C. Herb.; Knoxville, *A. Ruth,* June, 1896, U. I. Herb.; Knoxville, *A. Ruth,* May 10, 1901, U.I. Herb.; Knoxville, *A. Ruth,* April, 1895, U.M. Herb.; Knoxville, *A. Ruth,* April, 1894, U.M. Herb.; Knoxville, *A. Ruth,* April and May, 1897, two collections on one sheet, U.M. Herb.; Knoxville, *A. Ruth,* April, 1895, U.S.N.M. Herb. 286476; Knoxville, *A. Ruth,* June, 1900, U.S.N.M. Herb. 391709; Knoxville, *A. Ruth,* May and June, 1895, U.S.N.M. Herb. 772174; Knoxville, *A. Ruth,* April and May, 1897, U.S.N.M. Herb. 313042; Knoxville, *A. Ruth,* May, 1898, U.S.N.M. Herb. 345444; Knoxville, *A. Ruth,* April, 1897, U.S.N.M. Herb. 958401; Knoxville, *A. Ruth,* April, 1895, U.S.N.M. Herb. 772175; Knoxville, *S. M. Bain,* April, 1894, U.S.N.M. Herb. 263003; Knoxville, *S. M. Bain,* April, 1894, U.S.N.M. Herb. 263004; Knoxville, *Bilt. Herb.* 1204c, May 1, 1903, U.S.N.M.

Herb. 958442. NORTH CAROLINA: Cedar Cliff Mountain, *Bilt. Herb.*, May 11, 1897, U.M. Herb.

6. SAXIFRAGA CAROLINIANA A. Gray Mem. Am. Acad. II, *3*: 39, 1846.

S. Grayana Britton, Mem. Torr. Club *5*: 178. 1894.

Micranthes Grayana (Britton) Small, Fl. S.E.U.S. 501. 1903.

Micranthes Caroliniana (A. Gray) Small, N. A. Flora *22*: pt. 2, 146. 1905.

Virginia and North Carolina, Britton in Manual, l. c. 480.

Virginia, Robinson and Fernald in Manual, l. c. 446.

Virginia and North Carolina, Small in Flora, 504. 1903.

Virginia and North Carolina, Britton & Brown in Illustrated Flora, l. c. 219.

Virginia, West Virginia and North Carolina, Johnson in Revision, l. c. 25.

SPECIMENS EXAMINED: VIRGINIA: Chatham Hill Gap, *J. K. Small*, June 13, 1892, U.M. Herb.

7. SAXAFRAGA CAREYANA A Gray, Lond. Journ. Bot. *2*: 116. 1843.

Micranthes Careyana (A. Gray) Small, Fl. S.E.U.S. 503. 1903.

North Carolina and Tennessee, Small in Flora, l. c. 503.

North Carolina, Johnson in Revision, l. c. 23.

North Carolina, Small in N. A. Fl. 142.

SPECIMENS EXAMINED: NORTH CAROLINA: Roan Mountain, *J. W. Chickering, Jr.*, July 5, 1880, U.M. Herb.

8. SAXIFRAGA TEXANA Buckley, Proc. Phila. Acad. 18661: 455. 1862.

Micranthes texana (Buckley) Small, Fl. S.E.U.S. 501. 1903.

Missouri and Texas, Britton & Brown in Illustrated Flora, l. c. 218.

Missouri and Texas, Bush, l. c. 140.

Missouri and Texas, Johnson in Revision, l. c. 55.
Texas and Missouri, Small in Flora, l. c. 503.
Arkansas and Texas, Small in North American Flora, l. c. 137.

A calciphile species inhabiting the limestone barrens of Southern Missouri, especially the Grand Falls Chert barrens, southeastern Kansas, Western Arkansas, Western Louisiana and Eastern Texas.

SPECIMENS EXAMINED: MISSOURI: Reding's Mill, *Bush* 5475, April 8, 1909, U.S.N.M. Herb. 671856; Reding's Mill, *Bush*, 5475, April 8, 1909, U.S.N.M. Herb. 648013; Reding's Mill, *E. J. Palmer* 1647, April 8, 1909, U.I. Herb.; Reding's Mill, *E. J. Palmer*, 19607, March 19, 1921, P. Herb.; Alba, *E. J. Palmer*, 17148, April 7, 1920, P. Herb. TEXAS: Brazos County, *H. Ness*, March 10, 1900, U.S.N.M. Herb. 386993; Hockley, *F. W. Thurow*, month not given, 1889, U.S.N.M. Herb. 44120; Limestone County, *J. F. Joor*, Spring, 1878, U.S.N.M. Herb. 44121; Groesbeck, Limestone County, *J. F. Joor*, 87, February 27, 1887, a place where Joor lived for several years.

Bush (3) cites "Groesbeck, *Joor*, 87, February 27, 1887," Johnson (7) cites "no State cited, February 27, 1878, J. F. Joor."

Bush (3) cites "between French Town and Dallas, *J. Reverchon*, 287."

Johnson (7) cites "between French Town and Dallas, *J. Reverchon*, 281."

9. SAXIFRAGA PETIOLARIS (Raf.) n. comb.

Hexaphoma petiolaris Raf. Fl. Tell. *2*: 67. 1836.

Saxifraga leucanthemifolia Michx. Fl. Bor. Am. *1*: 118. 268, 1803. Not *S. leucanthemifolia* La Peyr. 1803.

Saxifraga Michauxii Britton, Mem. Torr. Club *4*: 118. 1894.

Spatularia leucanthemifolia (Michx.) Haus. Saxifr. Enum. 48. 1821.

Spataluria Michauxii (Britton) Small, Fl. S.E.U.S. 502. 1903.

Spatularia petiolaris (Raf.) Small, N. Am. Fl. *22*: part 2, 150. 1905.

Hydatica petiolaris (Raf.) Small, Fl. S.E.U.S. 760. 1911.

Virginia and W. Virginia to Georgia, Britton in Manual, l. c. 480.

Virginia and North Carolina to Georgia, Robinson and Fernald in Manual, l. c. 446.

Virginia and Georgia to Tennessee, Small in Flora, l. c. 504.

Virginia to Georgia, Britton & Brown in Illustrated Flora, l. c. 221.

Virginia to Georgia, Small in North American Flora, l. c. 130.

Maryland, Virginia, Tennessee, North Carolina and Georgia, Johnson in Revision, l. c. 65.

A species of the mountainous regions of Virginia, North Carolina, Tennessee and Georgia. For those who prefer the name *Micranthes* as the generic name of these Saxifrages, I offer the name *Micranthes petiolaris* (Raf.) n. comb., for this species.

SPECIMENS EXAMINED: TENNESSEE: Roan Mountain, *Bilt. Herb.* 1231g, July 14, 1903, U.S.N.M. Herb. 959292; Roan Mountain, *R. Thaxter*, August 8, 1887, U.S.N.M. 415915; Roan Mountain, *A. S. Hitchcock*, July 27, 1905, U.I. Herb.; Mount Leconte, *Nile* 351, August, 1924, U.I. Herb.; Mount Leconte, *Kendall* 353, August 1924, U.I. Herb.

10. SAXIFRAGA PENNSYLVANICA L. Sp. Pl. 1753.

S. pennsylvanica minor D. Don, Trans. Linn. Soc. *13*: 384. 1852.

Micranthes pennsylvanica (L.) Haw. Saxifr. Enum. 45. 1821.

Maine to Ontario, Minnesota, Virginia, Iowa and Missouri, Britton in Manual, l. c. 479.

New England to Virginia, West to Minnesota and Missouri, Robinson and Fernald in Manual, l. c. 446.

Maine to Ontario, Minnesota, Virginia, Iowa and Missouri, Britton & Brown in Illustrated Flora, l. c. 219.

Maine and Ontario, to Minnesota, Virginia and Missouri, Small in North American Flora, l. c. 139.

A paludicole species of the Eastern States, usually found in swamps and wet meadows, low wet swales on the prairies and similar situations, extremely variable and therefore presenting many more or less marked forms or individuals, some of which have been taken up by Johnson (7) for species, and these I will take into consideration further on in this paper.

SPECIMENS EXAMINED: NEW HAMPSHIRE: Hanover, *C. H. Hitchcock*, June 9, 1883, U.M. Herb. MASSACHUSETTS: Hadley, *G. C. Woolson*, May, 1870, U.I. Herb.; Somerville, *W. H. Manning*, 852, May 26, 1879, U.M. Herb. NEW JERSEY: Birmingham, *H. M. Willmarth*, May, 1883, U.I. Herb.; Eagle Rock, *K. K. Mackenzie*, 129, May 17, 1903, D. Herb.; Passaic, *E. W. Berry*, May 30, 1895, U.I. Herb. NEW YORK: McLean, *E. J. Durand*, May 23, 1891, U.M. Herb. PENNSYLVANIA: Penryn, *A. A. Heller*, May 30, 1890, U.M. Herb. OHIO: No locality given, *G. H. French*, no date given, U.S.N.M. Herb. 958396, three plants on this sheet, the ones marked 1 and 3; Georgia Lake, *L. D. Stair*, June 2, 1894, U.S.N.M. Herb. 958404; Mansfield, *E. Wilkinson*, 3178, May 20, 1899, U.S.N.M. Herb. 958492; Oberlin, *C. A. Kofoid*, May 21, 1891, U.S.N.M. Herb. 892351; Oberlin, *A. R. Ricksecker*, May 19, 1894, U.S.N.M. Herb. 217469; Oberlin, *A. E. Ricksecker*, May 29, 1895, U.S.N.M. Herb. 286712; Geauga Lake, *L. D. Stair*, June 2, 1894, U.S.N.M. Herb. 307940; Oberlin, *A. E. Ricksecker*, May 19, 1894, U.S.N.M. Herb. 251241; Richland County, *E. Wilkinson*, 3178, May 20, 1899, U.M. Herb.; Liverpool, *J. R. Watson*, June, 1896, U.M. Herb.; Munson, *J. R. Watson*, June 7, 1897, U.M. Herb.; Munson, *G. B. Ashcroft*, June, 1897, U.M. Herb. MASSACHUSETTS: Monson, *E. L. Morris*, May, 1884, U.S.N.M. Herb. 958396. NEW YORK: Ithaca, *W. W. Resole*,

June 1891, U.S.N.M. Herb. 958493. INDIANA: Clarke, *L. M. Umbach*, June 4, 1898, U.S.N.M. Herb. 339377; Clarke, *L. M. Umbach* 221, May 25, 1895, U. M. Herb; Miller, *R. Kienbolz*, May 26, 1918, U.I. Herb.; Miller, *A. Chase* 1792, May 30, 1902, U.I. Herb.; Thayer, *C. C. Deam*, 40557, June 6, 1924, D. Herb.; Norris Marsh, *C. C. Deam* 30930, June 7, 1920, D. Herb; Kramer, *C. C. Deam* 23034, May 15 1917, D. Herb.; Bluffton, *C. C. Deam* 3049, May 22, 1908, D. Herb.; Springport, *C. C. Deam* 44507, June 13, 1927, D. Herb.; Winchester, *C. C. Deam* 19689, May 16, 1916, D. Herb.; Bluffton, *C. C. Deam*, May 16, 1897, D. Herb.; Porter, *C. C. Deam* 20045, June 3, 1916, D. Herb.; Newberry, *C. C. Deam* 42793, May 19, 1926, D. Herb.; Michigan City, *C. C. Deam* 13051, May 28, 1913, D. Herb.; Ontario, *C. C. Deam* 15731, May 18, 1915, D. Herb.; Leesburg, *C. C. Deam* 30591, June 3, 1920, D. Herb.; Portland, *C. C. Deam* 19743, May 18, 1916, D. Herb.; Fountain, *C. C. Deam* 27327, May 9, 1919, D. Herb.; Harmony, *C. C. Deam* 12622, May 4, 1913, D. Herb. ILLINOIS: Oregon, *M. B. Waite*, June 17, 1885, U.S.N.M. Herb. 491007, two plants on this sheet, the one marked 2; Wady Petra, *V. H. Chase* 1344, May 19, 1907, U.S.N.M. Herb. 645279; Chicago, *W. S. Moffatt*, June 26, 1922, U.M. Herb.; Mount Carmel, *J. Schneck*, May 24, 1877, U.I. Herb.; Wady Petra, *V. H. Chase*, May 12, 1877, U.I. Herb.; Nail Mall, *S. O. Eaton*, date not given, U.I. Herb.; Peoria, *F. Brendel*, date not given, U.I. Herb.; Jo Daviess County, *H. S. Pepoon*, June, year not given, U.I. Herb.; Mascoutah, *W. Welsch*, date not given, U.I. Herb.; Beach, *F. C. Gates* 1675, June 16, 1907, U.I. Herb.; Peoria, *F. Brendel*, date not given, U.I. Herb.; no locality given, *J. Schneck*, date not given, U.I. Herb.; Woodford County, *F. E. McDonald*, June, 1887, U.I. Herb., two collections on this sheet; Shannon's Swamp, *J. Schneck*, April 25, 1882, U.I. Herb. MICHIGAN: Haslets, *T. T. Yuncker* 355, July 2, 1917, U.I. Herb.; Williamstown, *R. H. Ward*, June, 1857, U.I. Herb. MINNESOTA: Lake City, *S. M. Manning*, July 1, 1878, two collections on this sheet, one of which I destinguish as a variety of *pennsylvanica*, further on in this paper, N. M. Herb.;

Saint Paul, *R. Gmelin*, July, 1890, I.S.C. Herb.; Nichols, *E. P. Sheldon* 2305, June 1892, U.M. Herb.; Saint Croix Falls, *F. K. Butters, C. O. Rosendahl* and *A. M. Johnson*, June 5, 1920, U.M. Herb.; Bush Lake, *C. O. Rosendahl* and *F. K. Butters, June* 27, 1919, U.M. Herb.; Lake Johanna, *C. O. Rosendahl* 3808, June 18, 1919, U.M. Herb.; Rochester, *G. G. Ainslie*, May 24, 1902, U. M. Herb.; no locality given, *N. L. V.*, June 15, year not given, U.M. Herb.; Saint Louis County, *E. P. Sheldon* 4946, June 1893, U.M. Herb.; Winona, *J. M. Holzinger*, June 1, 1886, U.M. Herb.; Chaska, *C. A. Bullard*, June, 1891, U.M. Herb.; Milrea, *E. P. Sheldon* 3005, July, 1892, U.M. Herb.; Benedict, *H. J. Bergman* 3109, August 26, 1914, U.M. Herb. MASSACHUSETTS: Belmont, *F. P. Daniels*, June, 1898, U. M. Herb.

10A. SAXIFRAGA PENNSYLVANICA CRASSICARPA (Johnson) n. var.

S. crassicarpa Johnson, Rev. N. A. Sp. of SAXIFRAGA, 43. 1923.

Minnesota, Wisconsin and Illinois, according to Johnson, l. c. 42. 43.

I have studied this form very carefully, and have come to the conclusion that it can not be maintained as a species, if indeed it is anything more than a mere variation of *pennsylvanica*, but I am allowing it to stand as a variety of this species.

SPECIMENS EXAMINED: MINNESOTA: Saint Louis River, *J. C. Arthur, L. H. Bailey, Jr.* and *E. W. D. Holway* B329, July 23, 1886, TYPE of *S. crassicarpa* Johnson, U.M. Herb.; Lake Johanna, *C. O. Rosendahl* 3809, 3810 and 3811, June 18, 1919, N.M. Herb. These three collections are much better examples of what Johnson intended to typify in his *S. crassicarpa*, than are his type-specimens; Lake City, *S. M. Manning*, July 1, 1878, U.M. Herb., two collections on this sheet, one being typical *pennsylvanica;* Snelling Reservation, *C. O. Rosendahl* 2100, June 15, 1909, U.M. Herb., two collections on this sheet, one being what I am distinguishing as a variety

of *pennsylvanica* further on in this paper; Flensburg, *Chandonnet,* June 15, 1910. WISCONSIN: Kilbourne, *L. H. Pammel,* June, 1913, I.S.H. Herb. INDIANA: Lake Everett, *C. C. Deam* 14240, May 31, 1914, D. Herb.; Hamlet, *C. C. Deam* 30881, June 6, 1920, D. Herb.; Medarysville, *C. C. Deam* 40572, June 7, 1924, D. Herb.; Lake Gage, *C. C. Deam,* June 16, 1905, D. Herb.; Idaville, *C. C. Deam* 20166, June 7, 1916, D. Herb.

For those who prefer MICRANTHES as the generic name of these Saxifrages, I offer MICRANTHES PENNSYLVANICA CRASSICARPA (Johnson) n. var., as the name of this plant.

10B. SAXIFRAGA PENNSYLVANICA PURPURIPETALA (Johnson) n. var.

S. purpuripetala Johnson, Rev. N. A. Sp. of SAXIFRAGA, 51. 1923.

Vermont and New Jersey, according to Johnson, l. c. 52. 1923.

SPECIMENS EXAMINED: NEW YORK: North Harpersfield, *D. L. Topping* 72, June 20, 1906, U.M. Herb.; Ithaca, *W. C. Muencher* and *A. R. Bechtel* 192, June 20, 1897, I.S.C. Herb. VERMONT: Rutland, *W. W. Eggleston,* May 16, 1896, U.M. Herb. I have been unable to find any character that would separate this form from typical *pennsylvanica,* and it seems to occur throughout the range of this species. The purple color that Johnson lays so much stress on, seems to me to be only an individual character, and I am therefore reducing Johnson's species to varietal rank, and it really does not appear to me to deserve this. If it should be that the name MICRANTHES is accepted as the generic name of these Saxifrages, I offer MICRANTHES PENNSYLVANICA PURPURIPETALA (Johnson) n. var., as the name of this form.

10c. SAXIFRAGA PENNSYLVANICA WINNEBAGOENSIS (Johnson) n. var.

S. winnebagoensis Johnson, Rev. N. A. Sp. of SAXIFRAGA, 53. 1923.

SPECIMENS EXAMINED: MINNESOTA: Winnebago Valley,

Houston County, *W. A. Wheeler* 180, June 12, 1899, TYPE of Johnson's *S. winnebagoensis*, U.M. Herb.; Deer Creek, *A. M. Johnson, F. K. Butters* and *C. O. Rosendahl* 4086, June 14, 1921, U.M. Herb.

This form appears to me to be only a slight variation of *pennsylvanica* having smaller follicles than usual, and as many collections have been made along the Winnebago Valley without revealing any other specimens that agree with Johnson's description I suspect his to be only an individual variation of *pennsylvanica*. If this form is to be recognized as a variety, and the name MICRANTHES is applied to these species, I offer

MICRANTHES PENNSYLVANICA WINNEBAGOENSIS (Johnson) n. var., for this form.

10D. SAXIFRAGA PENNSYLVANICA FULTIOR (Fernald) n. var.
S. pennsylvanica forma *fultior* Fernald, Rhodora *19*: 141. 1917.

SPECIMENS EXAMINED: MASSACHUSETTS: Amherst, *E. L. Morris*, April, 1890, U.M. Herb. PENNSYLVANIA: Penryn, *A. A. Heller* and *E. G. Halbach* 872, May 27, 1893, I.S.C. Herb. ILLINOIS: Wady Petra, *V. H. Chase*, May 12, 1897, U.I. Herb.

Johnson does not give any range for this form, which seems to me to be only an individual variation of *S. pennsylvanica*, which possibly might be perpetuated in cultivation.

If it should prove to be only an occasional form of *S. pennsylvanica*, and be recognized as a form of that species, and the name MICRANTHES is accepted as the generic name of these Saxifrages, I offer MICRANTHES PENNSYLVANICA forma FULTIOR (Fernald) n. comb., for this form.

10E. SAXIFRAGA PENNSYLVANICA HIRSUTA n. var.

Leaves narrowly oblong, 6-10 inches long, 1 to 2 inches wide, obtuse, minutely serrulate all around excepting the broadly margined base, or sometimes entire, densely hirsute on both sides, especially at the broad dilated bases; stems 18 to 36 inches tall, thinly long-pilose below, glandular-pilose

above and near the top, the branches of the inflorescence also glandular-pilose; otherwise much as in typical *pennsylvanica*.

I can not be sure this is anything more than a mere state of *S. pennsylvanica*, although it looks very different from the ordinary state of that species, and it is just as much entitled to specific rank as several species described by Johnson.

In a species so very variable and so widely distributed as *S. pennsylvanica*, there are sure to be more or less different-looking individuals, but that these individuals are entitled to recognition as species, is something I can not favor.

SPECIMENS EXAMINED: MINNESOTA: Money Creek Valley, *C. O. Rosendahl* and *F. K. Butters* 4274, three sheets, June 2, 1922, U.M. Herb., TYPE; Gwinn's Bluff, *C. O. Rosendahl* and *F. K. Butters* 3965, two sheets, July 2, 1920, U.M. Herb.; Saint Croix Falls, *C. O. Rosendahl* and *F. K. Butters*, June 5, 1920, U.M. Herb. MICHIGAN: Hamilton, *C. L. Herron*, May 29, 1891, U.M. Herb. IOWA: Farley, *E. R. McGee*, May, 1893, U.M. Herb. MISSOURI: Jefferson County, *H. Eggert*, May 11, 1887, labaled *S. Forbesii*, but quite different from other specimens collected by Eggert on same date, same locality, also labeled *S. Forbesii*, U.M. Herb. ILLINOIS: Kankakee, *C. C. Crampton* 79, May 12, 1913, U.S.N.M. Herb. 750564; no locality given, *F. Brendel*, no month given, 1873, two plants on this sheet, the one marked 1, U.S.N.M. Herb. 44119.

Should this form prove to be a good variety, and the name *Micranthes* be accepted as the generic name of these Saxifrages, I offer MICRANTHES PENNSYLVANICA HIRSUTA n. var., for this form.

10F. SAXIFRAGA PENNSYLVANICA TOMENTOSA n. var.

Stems stout, 6 to 9 dm. tall, more or less short-pilose, leaves oblong, obtuse, minutely serrulate all around or entire, 6 to 20 cm. long, densely tomentose, especially near the base on the upper surfaces; upper part of the stem glandular-pilose; inflorescence narrow, densely glandular-pilose, the peduncles short, stout, mostly congested. Otherwise like in typical *pennsylvanica*.

Very different looking from *S. pennsylvanica*, as found in New England, but may be only a variation of that species.

Should it prove to be worthy of a name, and the name MICRANTHES is accepted for these Saxifrages, I offer MICRANTHES PENNSYLVANICA TOMENTOSA n. var., as the name of this form.

SPECIMENS EXAMINED: MINNESOTA: Minneapolis, *J. H. Sandberg*, May, 1894, U.M. Herb., TYPE; Goodhue County, *J. H. Sandbarg*, June, 1886, U.M. Herb.; Hennepin County, *J. H. Sandberg*, May, 1880, U.M. Herb.; Minneapolis, *J. C. Hassube*, May 1878, U.M. Herb.; Minneapolis, *Aiton*, May, 1878, U.M. Herb., marked forma *fultior* by Johnson; MacCubbin's Lake, *E. P. Sheldon*, May, 1895, U.M. Herb., marked forma *fultior* by Johnson; no locality, collector and date given, N.M. Herb.; Hennepin County, *F. H. Burglehaus*, May 12, 1891, U.M. Herb.; Rochester, *G. G. Ainslie*, 1831, date not given, U.M. Herb.; Snelling Reservation, *C. O. Rosendahl* 2100, June 15, 1909, two collections on this sheet, one of which I have distinguished above as a variety of *Pennsylvanica*, U.M. Herb. MICHIGAN: Jackson County, *S. H. Camp* and *Dr. R. Camp*, May 30, 1895, U.M. Herb.; Ann Arbor, *J. H. Ehler* 1471, May 17, 1921, U.I. Herb. IOWA: Fayette, *B. Fink*, May, 1893, I. S.C. Herb. ILLINOIS: Wady Petra, *V. H. Chase* 1344, May 19, 1907, U. I. Herb. INDIANA: Elkhart, *C. C. Deam* 33735, May 6, 1921, D. Herb.; Griffith, *C. C. Deam* 40520, June 5, 1924, D. Herb.; Rockford County, *C. C. Deam*, May 7, 1905, D. Herb.; Garrett, *C. C. Deam* 3013, May 17, 1908, D. Herb.; Mount Tom, *R. Kienbolz*, May 8, 1915, U.I. Herb.; Mineral Springs, *C. C. Deam* 12976, May 25, 1913, D. Herb.; Walkerton, *C. C. Deam* 33713, May 5, 1921, D. Herb. VIRGINIA: Williamsburg ,*E. J. Grimes* 3353, March 28, 1921, U.M. Herb.

10G. SAXIFRAGA PENNSYLVANICA DICHOTOMA n. var.

Stems 6 to 10 dm. tall; branches of the inflorescence slender, ascending or upcurced, sometimes springing from the base of the scapes; leaves long-oval, 1.5 to 3 dm. long, 5 to 8 cm. wide, mostly pubescent on both sides, or nearly glabrous, mostly denticulate or entire; inflorescence diffusely branched,

scarcely at all eymose; otherwise as in typical *pennsylvanica*. A very different looking plant from the ordinary *pennsylvanica*, and very likely only an extreme variation of that species.

SPECIMENS EXAMINED: MINNESOTA: Gwinn's Bluff, *C. O. Rosendahl* and *F. K. Butters* 4265, May 11, 1922, U.M. Herb., TYPE; Lake Johanna, *C. O. Rosendahl* 3808, June 18, 1919, U.M. Herb.; Lake Harriet, *L. R. Moyer* and *S. M. Manning*, June 20, 1895, U.M. Herb. INDIANA: Pokogon State Park, *C. C. Deam* 44304, May 26, 1927, D. Herb.; Kendallville, *C. C. Deam* 3089, May 31, 1908, D. Herb.; Ridgeville, *C. C. Deam* 19718, May 16, 1916, D. Herb.; Fremont, *C. C. Deam* 40494, June 4, 1924, D. Herb.

Should this form prove to be a good variety, and the name MICRANTHES be accepted for these Saxifrages, I offer for this form the name MICRANTHES PENNSYLVANICA DICHOTOMA n. var.

10H. SAXIFRAGA PENNSYLVANICA FORBESSI (Vasey) n. var.
S. Forbesii Vasey, Am. Entom. & Bot. *2*: 288. 1870.
Micranthes Forbesii (Vasey) Bush, Mo. Bot. Gard. Rept. *20*: 138. 1909.
Illinois and Missouri, Robinson and Fernald in Manual, l. c. 446.
Illinois and Missouri, Johnson in Revision, l. c. 44.
Saint Louis, Letterman in Tracy's Flora, l. c.
Illinois, Missouri and Iowa, Bush, l. c. 139.

Before Vasey described *S. Forbesii*, and prior to about 1880, all the collectors around Saint Louis, Eggert, Letterman, Engelmann, Trelease and others, called the tall Saxifrage of the Saint Louis region, *S. pennsylvanica*, and this is the name it appeared under in the Manuals and Floras. But after 1880 it was ascertained that *S. Forbesii* occured in that region, and so Eggert, Letterman and the later collectors began naming their collections of the tall plant *Forbesii*, and sending out specimens under this name. In this way it began to make confusion, and the Manuals and Floras either threw the Missouri plant called *Forbesii* into *S. pennsylvanica*, or else disregarded it entirely, and went back to the name *pennsylvanica*

for all of *S. Forbesii,* or at least the Missouri plants.

I have seen good specimens of these two forms collected by Eggert both labeled *S. Forbesii,* same label, same locality, same date and same habitat, thus showing that Eggert did not distinguish the two forms.

SPECIMENS EXAMINED: MISSOURI: Saint Louis, *H. Eggert,* May 1887, U.M. Herb.; Saint Louis, *H. Eggert,* May 11, 1887, U. M. Herb.; Jefferson County, *H. Eggert,* May 11, 1887, evidently the same collection, as the two preceding, which shows that Eggert did not collect this form in Saint Louis County, I.S.C. Herb.; Pacific, *H. Eggert,* May 8, 1886, I.S.C. Herb.; across the Meramec River, in Jefferson County, *H. Eggert,* May 8, 1886, I.S.C. Herb.; Jefferson County, *H. Eggert,* May 8, 1886, U.S.N.M. Herb. 958397; Pacific, Franklin County, *H. Eggert,* May 8, 1886, U.S.N.M. Herb. 754901; Allenton, *G. W. Letterman,* April 16, 1880, U.S.N.M. Herb. 986370; Saint Louis County, *G. W. Letterman,* April, 1880, U.S.N.M. Herb. 44170; Jefferson County, *G. W. Letterman,* April, 1880, U.S. N.M. Herb. 44112; Jefferson County, *G. W. Letterman,* month not given, 1880, U.S.N.M. Herb. 44111; Allenton, *G .W. Letterman,* month not given, 1882, U.S.N.M. Herb. 44113; Allenton, *G. W. Letterman,* April 16, 1880, two sheets, but evidently from across the river in Jefferson County, as is the next cited, I.S.C. Herb.; Allenton, *G. W. Letterman,* June 20, 1887, two plants on one sheet, evidently of two different collections, U.I. Herb. ILLINOIS: Oregon, *M. B. Waite,* June 17, 1885, U.S.N. M. Herb. 491007, two plants on this sheet, the one marked 1; Jackson County, *G. H. French,* May 9, 1873, U.S.N.M. Herb. 772168, three plants on this sheet, the ones marked 2; South Illinois, *G. H. French,* date not given, U.S.N.M. Herb. 44117; Jackson County, *G. H. French,* May 9, 1873, U.S.N.M Herb. 44114; South Illinois, *G. H. French,* month not given, 1875, U.S.N.M. Herb. 44115 and 44116; Oregon, *E. J. Hill,* July 11, 1905, U.I. Herb.

If this form is to be kept up, and the name MICRANTHES is accepted for these Saxifrages, I offer MICRANTHES PENNSYLVANICA FORBESII (Vasey) n. var. for this form.

LITERATURE CITED

1. Britton, Man. of the north. States and Can. 1909.
2. Britton & Brown, Ill. Flora, 1913.
3. Bush, Mo. Bot. Gard. Rept. 1909.
4. Eggert, Cat. Pl. of St. Louis, 1891.
5. Haworth, Syn. Pl. Succ, 1812.
6. Haworth, Saxifr. 1821.
7. Johnson, Rev. N. Am. Sp. *Saxifraga*, 1923.
8. Robinson and Fernold, Gray's New Man., 1908.
9. Small, N. Am. Flora, 1905.
10. Small, Flora S.E.U.S., 1903.
11. Tracy, Cat. Plants of Missouri, 1886.

OBSERVATIONS ON ORGANISMS AND SEDIMENTATION ON SHALLOW SEA-BOTTOMS

RUD. RICHTER

(Reviewed by Walter H. Bucher)

I.—INTRODUCTION

In the publications of the Senckenberg Museum at Frankfort a. M., Dr. Rud. Richter has published a series of observations on organisms and sedimentary processes on shallow sea-bottoms which he made in the North Sea off the coast of Schleswig-Holstein. His critical treatment of his observations based on a comprehensive knowledge of the literature (which is quoted extensively) makes these papers unusually valuable to the student of palaeo-ecology and of sedimentation. This is the first of several abstracts written in order to make this material more accessible to American students. A wealth of references and of critical detail had to remain untouched in these abstracts. For it the reader is referred to the original.

II.—*Scolithus* Hald. versus *Sabellaria alveolata* L.

1—Richter, Rud.—Ein devonischer Pfeifenquartzit, Senckenbergiana, Vol 2, 1920, Heft 6, pp. 215-235.

2—Richter, Rud.—Scolithus, Sabellarifex and Geflechtquarzite, ibid., Vol. 3, 1921, pp. 49-52.

3—Richter, Rud.—Sandkorallen-Riffe in der Nordsee, Natur und Museum, 57. Bericht der Senckenbergischen Gesellschaft, Frankfurt a. M., 1927, Heft 2, pp. 49-62.

4—Galeine, C. et C. Houlbert—Les récifes d'Hermelles et l'assèchement de la baie du Mont-Saint-Michel. Bull. Soc. géol. et min. de Bretagne, 2, (1921) 1922, pp. 319-324; (quoted in 3.)

In the fall of 1919, Dr. Richter observed, ten miles east of Büsum on the west coast of Holstein, large flat-topped reefs which, at low tide, stood as much as 30 cm. above the water surface (fig. 1-3, p. 222 of 1). They were found to consist entirely of closely packed tubes of the annelid *Sabellaria alveolata* L. Each individual of this worm is encased in a tubular sheath about 2 mm. in diameter, built of a mosaic of sandgrains cemented by a slimy secretion. Each tube is built up vertically from the surface of the sand by the animal, which occupies the tube head-up and reaches out with its tentacles for planctonic food. The tubes are so closely packed that only the width of a few sandgrains intervenes between adjacent ones, giving the surface of the reef the appearance of a huge, small-celled honey-comb, or of a coral colony such as Tubipora. Locally it is known as "sand coral." The whole mass, including the small amount of sand-matrix, is sufficiently cemented so that rolled fragments occur as pebbles, e. g. on the shore of the East Friesian island, Langeoog. Blocks weighing many pounds were shipped to the museum without difficulty.

The ecological aspect of these worm communities is striking. They are limited to pure sand bottoms practically free from mud. They lack practically all other larger forms of life. Only rarely a single valve of a pelecypod was seen caught between the tubes. The individual tubes are slightly wavy but never deviate much from a straight line. The organic cement is inconspicuous. It is obvious that after its destruction, in the fossil state it would be impossible to tell the sand grains that form the tube from the matrix which is more or less permeated by the same cementing secretion.

It is interesting that a closely related species, *S. spinulosa* Leuck, forms loosely intertwined tubes like the sand coral. It grows into solid colonies which encroach on oyster banks, completely overgrowing and destroying them.

This latter form seems to be well known to zoologists, while the straight-tubed form appears largely to have been overlooked even in zoological circles. With one obscure excep-

tion quoted by Dr. Richter, it seems to have escaped notice by geologists. Yet its existence solves the puzzle of the curious "pipe-rock" of the Cambrian of Fennoscandia and the Canadian shield and related early Paleozoic forms to which the name *Scolithus* was given in 1840 by Haldeman, and about which a voluminous, largely speculative literature has grown up.

The essential characteristics of *Scolithus* (e. g. *S. linearis* Hall of the Potsdam s. s.) may be listed as follows:

1.—More or less straight; often almost mathematically straight; simple tubes that never communicate or branch.
2.—Diam. from less than 3 mm. to over 12 mm.; length from a few cm. to over 1 meter.
3.—Interior of the walls often delicately annulated.
4.—Cutting across the strata parallel to each other and always normal to the bedding planes.
5.—In places so closely crowded that but few sand grains intervene between adjacent tubes.
6.—Limited to nearly pure sandstones.
7.—The sand between the tubes often distinctly and minutely bedded; the lines of bedding not disturbed where the tubes cut across them.
8.—Generally in beds devoid of other fossils.
9.—Widespread at definite stratigraphic horizons, (used successfully, for instance, by Peach in subdividing the Lower Cambrian of Scotland.)
10.—Limited to the Lower Paleozoic.

Points 9 and 10 speak forcibly against any suggested mechanical origin of these tubes, such as rising air or gas bubbles. The extreme case of crowding (5) also seems incompatible with a mechanical origin.

1, 5, 7 and 8 prove that these Scolithus tubes can not have been produced as tunnels by mud-eating worms burrowing in the sand.

No. 6 excludes the stems of algae as possible cause of these tubes, since algae do not grow on bottoms covered with drift-

ing, pure sand. For the existence of higher plants all proof is lacking.

All possible modes of origin suggested so far have failed. Each of the characteristics enumerated above, on the other hand, agrees with the observed habits of *Sabellaria alveolata*, such as the unbranched character of the tubes (1); the annulation of the inner walls which correspond to growth lines (3); the position of these tubes in the strata and their crowding (4 and 5); their restriction to pure quartz sand (6); the undisturbed lamination of the sand between them (7); the absence of other life (8), and the widespread distribution at definite stratigraphic horizons (9), and finally, the restriction to a limited division of time (10).

Fossil tubes distinctly referable to this type have been described from the Cambrian of Fennoscandia and Northeastern North America and from the Lower Silurian of New York. To these Dr. Richter adds a species from the Lower Devonian of the Eifel (2, pp. 215-217). No later record of similar tubes seems to exist. This may be due to a change in the nature of the slimy secretion of *Sabellaria*-like worms, which rendered the preservation of these tubes more difficult or impossible since the later Paleozoic,—or the habit of molding such straight tubes of sand mosaic may have arisen independently in different groups of annelids or even entirely different worm-like organisms. It seems wise, therefore, to retain the name *Scolithus* for the early Paleozoic tubes.

Dr. Richter proposes to limit the name *Scolithus* to the surprisingly, almost mathematically, straight forms which show a tendency to be closely crowded, especially in the Scandinavian specimens. For the other forms, which show slight undulations and less strictly parallel growth of the vertical tubes and a tendency to be less crowded, he proposes the name *Sabellarifex*.[1]

If field observations at the type localities of *Scolithus* s.

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1 *Sabellarites*, the name given in the first paper, had to be dropped because preoccupied by Dawson in 1890.

str. should show transitions between these types, the tentative name *Sabellarifex* would become superfluous.

It is obvious that most of the names attached to the various products of the activity of annelids in the geological past have little or no taxonomic significance. They do, however, represent distinct ecological types. As such these remains deserve careful attention. The formal relation between the various groups is brought out in the following tabulation quoted from Dr. Richter (1, p. 226) (with a few changes):

Types of Annelid remains:

A. Tubular sheaths built by tubicolous annelids.

1. Sheaths consist of a mosaic of sand grains cemented by an organic secretion.
   Sabellaria L. (?) (Secretion limited to sandy bottoms; chooses sand grains only, even when shell fragments abound (2, p. 50).
   Sabellarifex Richter.
   Scolithus Haldeman s. str.

2. Sheaths consist of a membraneous substance reinforced with agglutinated foreign bodies (fragments of shells, sand grains, etc.)
   Terebella Cuvier
   Terebellina Ulrich.
   Sabellarites Dawson (defined as "composed of sand and calcareous organic fragments, associated with carbonaceous flocculent matter, indicating a horny or membranous sheath—Q.J.G.S. Vol. 46, 1890, p. 605-6.)

3. Sheaths consist of calcium carbonate.
   Serpula L.
   Spirorbis Dandin.

B. Holes and burrows in the sediment made by Tubicola or by Errantia.

1. Tubular holes normal to bedding plane; cavities that held the cylindrical bodies of tubicolous annelids.
   Arenicola Linnaeus *Monocraterion* Torell
   Arenicolites Salter *Diplocraterion* Torell
   Histioderma Kinehan
2. Irregular tubular cavities cut into sediment in any direction—burrows of mud-eating annelids.
   Planolites Nicholson
3. Cavities in hard parts of other animals produced by parasitic Errantia:
   Myzostoma Leuckart

C. Tracks on surface of sediment:
   Crossopodia McCoy *Myrianites* McLeay
   Nemertites McLeay

The ecologic aspects of the "sand corals" is further developed in the delightful, well-illustrated account in "Natur und Museum" (3). The straight organ-pipe form of tubes appears limited to the reefs whose surface lies close to the water surface, to the ceaseless action of breaking waves. It is clearly a response to specific mechanical conditions. If true, this is valuable information to the paleogeographer.

Reefs of *Sabellaria* form a barrier 3 km. wide and 10 km. long across the famous bay of Mont-Saint-Michel in the Bretagne, having grown 6 m. high, hastening the silting up of the bay. (4, quoted in 3). It is surprising that such aggressive reef-growth should have escaped wider notice. It is even stranger that apparently none of the experienced captains of ships in the service of the coast control in German waters have ever seen before 1919 such reefs as now exist, although *Sabellaria* has long been a familiar member of the North Sea fauna. It looks as if a widspread expansion of the reef-forming tendencies of *Sabellaria* had taken place within the last decade in North Sea waters. It is just such sudden expansions that have given us in the geologic past widely spread strata

of limited vertical extent such as the *Scolithus* beds in the lower Cambrian of Scotland.

Finally, these sand reefs offer wonderful illustrations of victory and defeat in the struggle of colonies of marine organisms. Oyster banks are strangled and overgrown by *Sabellaria*. *Sabellaria* reefs, in turn, are suffocated by the dense web of byssus threads spun by the myriads of Mytilus brood. Almost solid layers of byssus-bearing pelecypods overlying nearly pure sand piped with closely crowded *Scolithus*-like tubes,—what an unreasonable sequence of sedimentation we geologists would call this had we found it somewhere in the Paleozoic! Yet here Dr. Richter shows us photographs of just such reefs and their materials, some taken while the megaphone of the boat that could not reach him warned him of the returning tide.

A LIST OF PLANTS FROM THE MISSOURI OZARKS

H. W. RICKETT

The list which follows is based upon collections and observations made in the Ozarks of Missouri during August, 1927. The vegetation of this region is scantily represented in the Herbarium of the University of Missouri and imperfectly known at least to the botanists of that institution. An exploratory trip was therefore made in a truck belonging to the Department of Botany through certain parts of Southern Missouri. The route followed is indicated in the accompanying map. It was planned only with the aim of seeing as much of the country as possible in so limited a time without undue haste. The party camped along the way, and spent usually several days in each spot of interest. Most of the country covered supports a forest of oak, with a scattering of other trees, notably pine and hickory. In the valleys are cleared regions. Here and there arise the great springs, flowing perhaps several millions of gallons a day, creating moist places where various ferns flourish. In a few places, as noted below, swamps occur, with characteristic vegetation.

In addition to the species named in the list, casual notice was taken of others inhabiting the springs. These were not, for lack of proper equipment, collected and identified. The following were recognized: *Myriophyllum sp.*, in Meramec Springs, Phelps County: *Potamogeton sp.* (probably *P. pectinatus* L.) and *Naias sp.* in the spring at Yancy Mill, Phelps County; *Vallisneria spiralis L.*, in the spring at Howe's Mill; and *Radicula Nasturtium-aquaticum* (L.) Britten and Rendle, growing several feet in height from the bottom of the spring at Centerville, Reynolds County, also at Yancy Mill.

ited time forbad the inclusion of all groups. Neither are Bryophytes included in the list, since these were

not studied carefully. Passing mention can be made of the abundance of mosses at the Shut-In of the Black River,

notably Climacium, Thuidium, Dicranum, Catharinea, Entodon. Polytrichum, which is apparently rare in Missouri, was found on the granite boulders near Graniteville. Of the liverworts, Porella and Conocephalum were found near the water at Big Spring State Park, Van Buren; and Marchantia by Meramec Spring.

A noteworthy feature of the vegetation is the prominence of Leguminosae. This family was represented by thirty-two species in ten genera, and was abundant everywhere, especially the various species of Desmodium and Lespedeza. The characteristic habitat of the family is the dry, oak-covered hillsides.

The Leguminosae were exceeded in number of species only by the Compositae; these, however, had not yet attained their greatest abundance. Most of the Asters and Golden Rods had not yet come into bloom.

Certain members of the Labiatae were very abundant. The straggling stems of Dittany (Cunila) contended with Desmodium for the ground under the oaks on the hills; and the odorous Pennyroyal (Hedeoma) covered the openings and disused roads.

The ferns were well represented only near the springs and on the rocks of the Shut-In of the East Fork.

A detailed list follows of the stations at which collections and observations were made, in the order in which they were visited.

1. Marie's Creek, Westphalia, Osage County.
2. Highway 63, detour between Vienna and St. James, Marie's County.
3. Meramec Spring and neighborhood, Phelps County.
4. Little Piney Creek on Highway 63, Phelps County; a sandy and stony creek bottom well covered by sycamore.
5. Yancy Mills, a quarter mile from the preceding; road through woods, a spring, a swamp, and cornfields.
6. Highway 32 between Licking and Salem, Dent County.
7. Camp ground at Salem, Dent County; a vacant lot at the edge of the town.
8. Howe's Mill, Dent County; including a small swamp near the spring.
9. Granite boulders near Graniteville, Iron County.

10. Highway 21 between Glover and Lesterville, Iron County.

11. On the East Fork of the Black River, near Lesterville, Reynolds County; including a curious mixture of sand, bearing Opuntia, with swamp.

12. Bluff above East Fork near Lesterville.

13. Big Shut-In of the East Fork and neighborhood; an interesting formation caused by the prominence of old granite and basalt rocks through the softer limestone.

14. Shut-In Creek; a tributary of the East Fork some five miles from the Big Shut-In, which has cut down to the same rocks.

15. Big Spring State Park, near Van Buren, Carter County.

16. Highway 60 near Birch Tree, Shannon County; in the midst of a high, flat, and dry country which occupies the central Southern portion of the State.

17. On the Piney Fork near Cabool, Texas County.

18. Near Smittle Cave, Wright County.

19. Bennett Spring State Park, Laclede County.

LIST OF PLANTS

The numbers in parentheses which follow the names refer to the places of collection; each number refers to the station so numbered in the list above.

For convenience in reference, the terminology accords with that in Gray's New Manual of Botany, 1908.

POLYPODIACEAE

Adiantum pedatum L. (13, 15)
Aspidium marginale (L.) Sw. (9, 13, 15)
Asplenium angustifolium Michx. (15)
A. platyneuron (L.) Oakes. (13, 15)
A. Trichomanes L. (13)

TWENTY-FIVE

Camptosorus rhizophyllus (L.) Link. (15)
Cheilanthes Feei Moore. (13)
Cystopteris bulbifera (L.) Bernh. (13, 15)
Pellaea atropurpurea (L.) Link. (13, 15)
Phegopteris Dryopteris (L.) Fee. (13)
P. hexagonoptera (Michx.) Fee. (13)
Polypodium polypodioides (L.) Hitchc. (13)—growing on rock overhanging smaller spring.
Polystichum acrostichoides (Michx.) Schott. (13, 15)
Woodsia obtusa (Spreng.) Torr. (13)

OPHIOGLOSSACEAE

Botrychium virginianum (L.) Sw. (13)

ALISMACEAE

Lophotocarpus calycinus (Engelm.) J. G. Sm. (8)

COMMELINACEAE

Commelina virginica L. (4, 15)

LILIACEAE

Allium cernuum Roth. (5)

IRIDACEAE

Belamcanda chinensis (L.) DC. (5)

ORCHIDACEAE

Hexalectris aphylla (Nutt.) Raf. (4)—one plant, high on bluff.

URTICACEAE

Pilea pumila (L.) Gray. (7)

POLYGONACEAE

Polygonum Hydropiper L. (4, 11, 13, 18)
P. lapathifolium L. (4)
P. Persicaria L. (5)
P. scandens L. (5, 13, 15)
P. virginianum L. (11, 13, 15)

PHYTOLACCACEAE

Phytolacca decandra L. (5, 13)

AIZOACEAE

Mollugo verticillata L. (4)

CARYOPHYLLACEAE

Dianthus Armeria L. (4)
Saponaria officinalis L. (4, 11, 13)

RANUNCULACEAE

Aquilegia canadensis L. (15)
Cimicifuga racemosa (L.) Nutt. (13)
Hepatica acutiloba DC. (12)

CAPPARIDACEAE

Polanisia trachysperma T. & G. (11)

CRASSULACEAE

Penthorum sedoides L. (8)

SAXIFRAGACEAE

Heuchera sp. (H. americana L. ?) (13, 15)

ROSACEAE

Agrimonia mollis (T. & G.) Britton. (2, 13, 16)
A. striata Michx. (12)
Geum canadense Jacq. (5, 15)
Gillenia stipulata (Muhl.) Trel. (12)
Potentilla canadensis L. (13)
P. monspeliensis L. (5)
Rosa humilis Marsh. (13)
Rubus villosus Ait. (13)

LEGUMINOSAE

Amorpha canescens Pursh. (13)
Amphicarpa Pitcheri T. & G. (5, 10, 12, 13, 16)
Cassia Chamaecrista L. (5, 13, etc.)
C. Medsgeri Shafer (11)
C. nictitans L. (2, 5, 8, 11, 18)
Desmodium bracteosum (Michx.) DC. (8)
D. canescens (L.) DC. (5)
D. Dillenii Darl. (5, 12)
D. grandiflorum (Walt.) DC. (8, 12, 18)
D. laevigatum (Nutt.) DC. (12)
D. marilandicum (L.) DC. (13)
D. nudiflorum (L.) DC. (8)
D. obtusum (Muhl.) DC. (12, 16)
D. paniculatum (L) DC. (17)
D. paniculatum pubens T. & G. (5)
D. rigidum (Ell.) DC. (16)
D. rotundifolium (Michx.) DC. (12, 18)

D. sessiliflorum (Torr.) T. & G. (3)
D. viridiflorum (L.) Beck. (18)
Lespedeza frutescens (L.) Britton. (12)
L. hirta (L.) Hornem. (9, 12, 18)
L. procumbens Michx. (10, 16)
L. repens (L.) Bart. (8, 10, 13, 18)
L. striata (Thumb.) H. & A. (8, 13, 18)—common by roadsides.
L. Stuvei Nutt. (4)
L. virginica (L.) Britton. (12, 13, 16)
Schrankia uncinata Willd. (16)
Strophostyles helvola (L.) Britton. (4, 12)
S. pauciflora (Benth.) Wats. (2)
Stylosanthes biflora hispidissima (Michx.) Pollard and Ball. (2, 12)—typically with *Lespedeza striata*
Tephrosia virginiana (L.) Pers. (16)

LINACEAE

Linum medium (Planch.) Britton. (13, 18)

OXALIDACEAE

Oxalis corniculata L. (5, 11)
O. repens Thunb. (11)
O. stricta L. (8, 13)
O. violacea L. (13)

POLYGALACEAE

Polygala sanguinea L. (4)
P. Senega L. (11)
P. Senega tenuifolia Pursh. (6)

EUPHORBIACEAE

Acalypha gracilens Gray. (13)
Croton capitatus Michx. (11)
C. glandulosus septentrionalis Muell. Arg. (5)
C. monanthogynus Michx. (4, 9, 11, 13)
Euphorbia corollata L. (3, 13, 16, 18)
E. heterophylla L. (4, 13)
E. Preslii Guss. (4, 11)

BALSAMINACEAE

Impatiens biflora Walt. (5, 18)

MALVACEAE

Abutilon Theophrasti Medic. (5)
Sida spinosa L. (1, 11)

HYPERICACEAE

Ascyrum hypericoides L. (12, 13)
Hypericum cistifolium Lam. (12)
H. gentianoides (L.) BSP. (9)
H. prolificum L. (13)
H. punctatum Lam. (5, 13)

VIOLACEAE

Hybanthus concolor (Forster) Spreng. (12)
Viola pedata L. (9)—in flower

CACTACEAE

Opuntia Rafinesquii Engelm. (11, 13)

LYTHRACEAE

Cuphea petiolata (L.) Koehne. (3, 5, 11, 13, 18)
Lythrum alatum Pursh. (4)

ONAGRACEAE

Epilobium coloratum Muhl. (8)
Gaura biennis L. (4, 11, 13, 15)
Ludvigia alternifolia L. (14)
Oenothera biennis L. (4, 5, 13, 15)—common throughout
O. laciniata Hill. (11)

UMBELLIFERAE

Daucus Carota L. (13)
Sanicula sp. (12, 13)
Thaspium sp. (12)
Zizia sp. (12)

PRIMULACEAE

Steironema quadriflorum (Sims) Hitchc. (8)

ASCLEPIADACEAE

Asclepias incarnata L. (8)
A. purpurascens L. (11)
A. verticillata L. (13)

CONVOLVULACEAE

Convolvulus sepium L. (13)
Cuscuta sp. (5)
Ipomoea hederacea Jacq. (5, 11, 13)
I. pandurata (L.) G. F. W. Mey. (3)
I. purpurea (L.) Roth. (5)

POLEMONIACEAE

Phlox pilosa L. (12, 13)

BORAGINACEAE

Echium vulgare L. (11)
Heliotropium tenellum (Nutt.) Torr. (12)
Lappula virginiana L. (11, 13)

VERBENACEAE

Lippia lanceolata Michx. (8)
Verbena angustifolia Michx. (5, 11, 13)
V. canadensis (L.) Britton. (11, 13)
V. strica Vent. (4, 11, 13)
V. urticaefolia L. (4, 11, 13)

LABITAE

Blephilia sp. (12)
Collinsonia canadensis L. (12)
Cunila origanoides (L.) Britton (8, 12, 13, 16, 18)—common in oak woods.
Hedeoma pulegioides (L.) Pers. (8, 11, 13)—common throughout.
Isanthus brachiatus (L.) BSP. (11)
Lycopus americanus Muhl. (11)
Mentha citrata Ehrh. (?) (8)—possibly a large form of *M. piperita*
M. piperita L. (8)
M. spicata L. (5)
Monarda Bradburiana Beck. (8, 13, 18)
M. fistulosa L. (5)
Nepeta Cataria L. (3)
Physostegia virginiana (L.) Benth. (8, 13)
Prunella vulgaris L. (4, 13)
Pycnanthemum flexuosum (Walt.) BSP. (6, 13)
P. pilosum Nutt. (3, 5)
P. virginianum (L.) Durand and Jackson (8)
Satureja glabra (Nutt.) Fernald. (11)
Scutellaria canescens Nutt. (6)
S. lateriflora L. (13)
S. versicolor Nutt. (12, 13)
Stachys tenuifolia Willd. (5, 13)
Teucrium canadense L. (12)
Trichostema dichotomum L. (9, 13)

SOLANACEAE

Datura Stramonium L. (5, 13)
Solanum carolinense L. (5, 11, 13)
S. nigrum L. (13, 18)

SCROPHULARIACEAE

Gerardia grandiflora Benth. (5, 18)
G. pedicularis L. (16)
G. Skinneriana Wood (16)
G. virginica (L.) BSP. (8, 12)—corolla glabrous within except at base.
Mimulus alatus Ait. (3, 8, 11)
Verbascum Blattaria L. (8, 11, 13)
V. Thapsus L. (4, 11, 13)
Scrophularia marilandica L. (5)

ACANTHACEAE

Ruellia pedunculata Torr. (12)
R. strepens L. (8)—in flower.

PHRYMACEAE

Phryma Leptostachya L. (12)

PLANTAGINACEAE

Plantago major L. (5)

RUBIACEAE

Cephalanthus occidentalis L. (11)
Diodia teres Walt. (4, 11, 13)—thick mats on roadsides.
Galium arkansanum Gray. (12)
G. pilosum Ait. (12, 13)
G. triflorum Michx. (15)
Houstonia angustifolia Michx. (4, 11, 13)

CAPRIFOLIACEAE

Symphoricarpos orbiculatus Moench. (5, 12, 13)—fruit.
Triosteum sp. (13)—fruit.
Viburnum alnifolium Marsh. (4)—coarsely-toothed ovate leaves.

CAMPANULACEAE

Campanula americana L. (5, 11, 15, 18)

LOBELIACEAE

Lobelia inflata L. (5, 12, 13)
L. siphilitica L. (8, 18)
L. spicata Lam. (12)

COMPOSITAE

Actinomeris alternifolia (L.) DC. (1, 5, 11, 13, 17)—common along roadsides.
Ambrosia artemisiifolia L. (5, 13)
A. bidentata Michx. (13)
A. trifida L. (5, 17)

Anthemis Cotula L. (5, 11, 13)
Arctium Lappa L. (5)
Aster anomalus Engelm. (12, 13, 18)
A. ericoides L. (5, 13, 15)—very abundant locally.
A. patens Ait. (3, 8, 13, 16)
A. sagittifolius Wedemeyer (17)
Bidens bipinnata L. (5, 11, 13)
Cacalia atriplicifolia L. (11, 13)
Chrysanthemum leucanthemum L. (8, 13)
Cirsium altissimum (L.) Spreng. (8, 11, 13)
C. lanceolatum (L.) Hill. (13)
Coreopsis lanceolata L. (13)
C. palmata Nutt. (2)
C. tripteris L. (13)
Elephantopus carolinianus Willd. (1, 5, 11, 13, 15)—common in woods.
Erigeron ramosus (Walt.) BSP. (5, 13, 15)—in flower.
Eupatorum coelestinum L. (11, 19)
E. perfoliatum L. (5)
E. purpureum L. (11)
E. serotinum Michx. (4, 15)
E. urticaefolium Reichart. (17, 19)
Helenium autumnale L. (4, 8)
H. nudiflorum Nutt. (3, 5, 8)
H. tenuifolium Nutt. (9, 11, 13)—abundant along roadsides and in fields.
Helianthus hirsutus Raf. (13)
Heliopsis scabra Dunal. (10, 12, 13)
Hieracium Gronovii L. (3, 18)
H. longipilum Torr. (9, 12)
H. scabrum Michx. (13)
Krigia amplexicaulis Nutt. (18)—in flower.
Lactuca canadensis L. (16)
Liatris cylindracea Michx. (13)
L. scariosa Willd. (4)
L. squarrosa Willd. (13)
Polymnia canadensis radiata Gray (15, 19)
Pyrrhopappus carolinianus (Walt.) DC. (5)
Rudbeckia fulgida Ait. (12)
R. hirta L. (5)
R. laciniata L. (13, 15)
R. subtomentosa Pursh. (8)
R. triloba L. (5, 8, 12, 13, 17)—common throughout.
Silphium integrifolium Michx. (5, 12)
S. perfoliatum L. (5)

S. terebinthinaceum Jacq. (8, 12)
Solidago hispida Muhl. (13)
S. nemoralis Ait. (13)
S. ulmifolia Muhl. (3, 17)
Verbesina virginica L. (11)
Vernonia altissima Nutt. (15)
V. Baldwini Torr. (5, 8, 11)
V. crinita Raf. (4, 8, 11, 13)
V. illinoensis Gleason (7)
V. interior Small (8)—(included by Gray in *V. Baldwini.*)

NOTES ON THE GENUS HYDRANGEA

T. G. HARBISON

Hydrangea arborescens L. is admissibly a very variable species, but my observation of this species over a wide territory for many years leads me to believe that at least one variety is distinct enough to be worthy of a anme. Extending from Union Springs, Bullock county, Alabama, to Forestville, Wake county, North Carolina, in the upper Piedmont country there is a variety of Hydrangea arborescens L. with deeply cordate, broadly ovate, abruptly acuminate leaves, glabrous on the under side with very short petioles. This variety is represented in the National Herbarium by material from Union Springs, Bullock county, Alabama, Biltmore Herbarium, June 18, 1902; Forestville, Wake county, North Carolina, Biltmore Herbarium, June 14, 1900; Kennesaw Mt., Cobb county, Georgia, Biltmore Herbarium, June 24, 1899; also from Kennesaw Mt. by Percy Wilson, June 12, 1900. The specimen in the National Herbarium bearing the number 1339i, collected by the writer at Union Springs, Alabama, June 18, 1902, is suggested for the type of

HYDRANGEA ARBORESCENS var. AUSTRALIS, n. var.

Differs from the type in its deeply cordate and more broadly ovate leaves which are abruptly acuminate and in its short petioles which are less than half as long as the blades. The leaves of this variety seem to be consistently glabrous whereas in the type leaves more or less pubescent are not uncommon.

Mr. W. W. Ashe has sent me specimens of a species of Hydrangea from Arkansas both in flower and fruit that does not agree with any of the described species of this genus. I take pleasure in associating the name of the discoverer with this species.

HYDRANGEA ASHEI, n. sp. A shrub 4 to 8 dm. tall with clustered stems; winter twigs of the year angled with smooth and tan-colored bark; bark on the older stems exfoliating in thin layers, the inner bark greenish gray. Leaves ovate, broadly ovate, to orbicular-ovate, or rarely oblong-ovate, from 7 to 11 cm. long by 4 to 9 cm. broad, abruptly taper-pointed, rounded, subcordate or cordate at the base, coarsely and sharply serrate with straight teeth nearly to the base; the lower surface permanently pubescent with short simple hairs on the surface of the blade as well as on the veins! petioles flattened and pubescent on the upper surface, rounded and glabrous on the lower.

Inflorescense a compound cyme, 4 to 12 cm. wide and from 3 to 6 cm. high, more or less pubescent, the peduncle eventually nearly glabrous; flowers appearing the last of June to the middle of July or occasionally later are cream-colored, the perfect ones about 2.5 mm. long including the stamens, with fugacious orbicular petals about 1 mm. in diameter, anthers cream-colored; calyx a crown with pointed teeth; the usually few marginal sterile flowers are about 12 mm. wide, the small segments orbicular-ovate to orbicular. Fruit maturing in September or later is prominently about 10-ribbed, barely 2 mm. long including the short persistent spreading styles, and about the same width.

The proposed species seems to be essentially Ozarkian in its distribution, extending according to Mr. Ashe's specimens from Montgomery county, Arkansas to Stone county in the same State. He reports it as being not uncommon along rocky banks of small streams but also as entering moist stony woods as near to summit of the north slope of Boston mountain in Newton county, Arkansas.

The affinities of this proposed species, in its broadly ovate and cordate leaves, in its pubescence and in its small marginal sterile flowers seem to be with Hydrangea cinera Small rather than with Hydrangea arborescens L. which it superficially resembles. H. arborescens rarely has cordate leaves whereas at least the lower leaves of this plant are prevailingly

cordate. The lower surface of the leaves of H. arborescens are essentially glabrous except on the veins, but the leaves of his species on their entire lower surface are invariably pubescent. The sterile flowers of H. arborescent as a rule are about twice the size of those of the proposed species, and both fertile flowers and capsules of H. arborescens seem to be consistently larger. In comparison with H. cinerea its pubrescense is much less copious, never sufficient to whiten the lower surface of the leaf.

Mr. Ashe reports having had this species in cultivation in Washington, D. C., since 1926, it having bloomed and fruited freely two seasons. These plants came from Montgomery Creek, Montgomery county, Arkansas, along the stony banks of which it is common in deep hollows. Fresh material from these cultivated plants was furnished me for study and comparison with that of H. cinerea and H. arborescens, both of which are found on the Highlands Plateau. The type material upon which I have based my description of this proposed species is from Montgomery Creek, Montgomery County, Arkansas.

T. G. HARBISON

Highlands, N. C.

A SIMPLE TRAP FOR THE CAPTURE OF TERRESTRIAL ISOPODS*

S. W. GEISER, PH.D.

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Students of the terrestrial isopods know how difficult it is to collect in quantities certain small and active species of these animals, or the young of the larger species. In the past, the writer, for example, when collecting such small forms could proceed only by scooping up with a trowel into an earthen pot quantities of soil, leaf-mould, etc., containing such forms in large numbers. The pot was then taken to the laboratory; the material, in small amounts, laid out upon a glass plate or a piece of glazed paper, and the individuals picked out slowly as search among the material revealed them. In this way limited amounts of the desired material were secured. However, with the most expert collecting many, in fact, *most* of the more active individuals escape of such species as *Metoponorthus pruinosus, Porcellio laevis,* etc. The below method, devised by the writer in connection with certain problems regarding distribution, sex-ratio, color-variation, sexual periodicity, and migration of the Isopods, during the past three years, has given most excellent results. In the course of this work I employed a simple but most effective trap made of a potato or carrot. The trap also frequently yields myriapods, arachnids, and occasionally small beetles, and the method seems well worth publishing.

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* The writer quite unconsciously followed in this device a method which, according to GRAEVE (*Inaugural-Dissertation, Bonn,* 1913) has been for some time used by German mushroom-growers for the capture of *Porcellio laevis!* Mature reflection suggests the desirability of publication of the method, which is deserving of a better acquaintance among students of the Isopoda.

An ordinary potato is bored completely through lengthwise with a large cork-borer in the manner of preparing potato-plugs for bacteriological use. Long, thin potatoes make the best traps, and only one plug of potato is removed. A short section of the plug removed is cut off to serve as a stopper at one end of the potato, the other end being left open. After preparation, the traps should be laid in piles of litter where sowbugs are known to be abundant and lightly covered with litter. They may be baited at first with bacon (although this is not often necessary).

After the trap has been in place for some time it is uncovered and held horizontally while the litter is removed from the surface of the potato. The trap is then held vertically, sharply tapped, and the contents of the trap shaken into a dry, white porcelain evaporating dish. The material is then cleaned, dropped (if desired) into 80% alcohol, and then picked over at will.

With these traps the writer has obtained in abundance species that by ordinary methods of collection are "rare" for this locality. For instance, *Philoscia muscorum*, which appears very rarely in my older records now appears frequently in my collections. All sorts of rare juvenile stages also are obtained, and in a clean, bright condition. A small trap will sometimes yield on a good haul 60 individuals, while a large, much-eaten trap may contain as many as 300 adults of *Armadillidium or Porcellio laevis*. Small traps may have as many as 150 young *Metoponorthus* or *Porcellio laevis* or *Armadillidium vulgare*. Swift-moving species are collected with the loss of very few individuals by the use of the potato-trap. The writer suggests that this method be used with the smaller species which are collected with difficulty in the old way.

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CONTRIBUTIONS TO THE BOTANY OF MICHIGAN, NO. 16.—MISCELLANY.

OLIVER ATKINS FARWELL

Lilium Michiganense Farw. Wild Red Lily. In sparse woods and open fields on Belle Isle, where it was once abundant. No. 1268a, July 21, 1892. The var. *uniflorum* Farw. is probably the most abundant form of the species, but it is given a close run by the following variety. Detroit: Belle Isle, No. 1674c, July 13, 1900; Linden Park, No. 1608a, July 9, 1898 and No. 1777a, July 12, 1902. Variety *umbelliferum* Farw. Detroit, No. 1607a, July 9, 1898.

Dioscorea villosa Linn. Wild Yam. A climbing vine similar to *Smilax*, but more slender and unarmed. Yellowish flowers in axillary panicles. Climbing over shrubs and herbs in moist thickets. The Yam family is one of the few monocotyledonous groups that have netted-veined leaves. A tropical species produces a tuber that is highly prized as an article of food. The fruit is a membranaceous, three-winged capsule. The rhizome is largely used in medicine. In the typical species the rhizome is very slender and the leaves are pubescent to glabrate underneath. Ypsilanti, No. 1156, June 23, 1891. Detroit: Belle Isle, No. 1156a, August 13, 1892 and No. 1673a, June 29, 1900; Mack Avenue woods, No. 2026½, June 30, 1907. Parkedale, No. 2867½, July 14 and No. 3040, August 4, 1912. A variety with glabrate to glabrous leaves is var. *glabrifolia* (Bartlett) n. comb. (*D. paniculata* Mx., var. *glabrifolia* Bartlett). Detroit (Mack Avenue woods), No. 2025, June 23, 1907. Another variety, var. *glabra* Lloyd, has a much larger and more contorted rhizome, petioles pubescent at the apex, leaves usual-

ly glabrous beneath, but often more or less pubescent, and glaucous when mature. It is the rhizome of this variety that constitutes the greater part of the medicinal drug of today. Algonac, No. 2721a, June 16, 1912.

Prof. H. H. Bartlett in 1910 published a revision of the U. S. species of *Dioscorea* as Bulletin 189 of the Bureau of Plant Industry, U. S. Dept. of Agriculture. He recognized five species, two of them new, and adopted *D. paniculata* Mx. for *D. villosa* Linn. On the map illustrating the distribution of this species, it is not represented in the region south of the Ohio and Potomac rivers, yet the specimen of Clayton, which came from Virginia, is acknowledged by Mr. Bartlett to be *D. paniculata* Mx. Small, in the appendix of the second edition of his Flora of the Southern U. S., adopts the revision of Prof. Bartlett, giving essentially the same ranges. In *D. glauca* Muhl. (var. *glabra*, above) Bartlett says of the leaves, usually glabrous beneath, while Small says, usually finely pubescent; both say, glaucous. Bartlett cites a specimen of A. H. Curtiss, Bedford Co., Va., No. 43953, under *D. glauca*. In the herbarium of Parke, Davis & Company in a specimen of *D. glauca* collected in Bedford Co., Va., by A. H. Curtiss in May, year not given. It is a flowering specimen and the leaves are paler beneath but show no sign of glaucosity; they are rather densely but minutely pubescent. The range is given as Penna. to Mo. and S. C.; that of the variety *glabrifolia*, Conn. to Md. and, skipping the intermediate regions, Mo. and eastern Tenn. to Tex. It will be seen that Michigan is beyond the ranges given for the above named varieties; nevertheless we have them.

Salsola Kali Linn. Russian Thistle. The glabrous state of the type was gathered at Linden Park in Detroit. The fruit is lead-colored. No. 1407a, August 8, 1893.

Salsola Kali Linn, var. *Caroliniana* (Walt.) Nutt. Like the above but fruit larger and roseate; in drying the color is apt to disappear. Marquette, No. 1475a, August, 1900. Detroit: Linden Park, No. 1764½, Sept. 26, 1901 and No. 1872½, Sept. 9, 1904. Northville, No. 6447, Oct. 18, 1922, wrongfully referred in an earlier report to the next variety.

Salsola Kali Linn, var. *tenuifolia* Tausch. Pubescent,

leaves filiform and elongated, fruit lead-colored. Detroit, No. 1475, July 23, 1894 and No. 3216, Oct. 20, 1912. Rochester, No. 2960, July 28, 1912 and No. 3219, Oct. 27, 1912.

Sagina nodosa (Linn) Fenzl. Pearlwort. A slender plant of the Pink family, usually found on wet, rocky shores. A few miles northwest of Clifton on the shores of Lake Superior, No. 363, June 1, 1886. The typical plant has glabrous calyx, pedicels, etc.; but a variation has those parts glandular and is var. *glandulosa* (Bess.) Presl. On wet, rocky shores of Lake Superior at Copper Harbor, No. 7752½, August 5, 1926.

Rubus parviflorus Nutt. In Michigan this species is commonly called Thimbleberry. Salmon Berry is an unheard of name. The flowers are of medium size, white, the petals averaging about one-half of an inch. The fruit is much sought by everyone wherever the plant occurs, for it makes delicious pies, jam, etc. Rocky woods, etc. Cliff Mine, No. 262, July 15, 1885. Copper Harbor, No. 1611b, August 20, 1898. Marquette, No. 262a, July 6, 1895. Lake Linden, No. 6591, June 25, 1923. [The western plant has flowers about twice as large, petals averaging about one inch, and the plants are less harsh. The leaves and stems are of a pale green, those of the eastern plants being of a yellowish green. It may be known as var. *grandiflora* n. var. (*R. Nutkanus Moc.*) A variation of this, on the Pacific coast mainly, has the leaves densely tomentose beneath and this may be known as subvar. *velutinus* (*Rubus velutinus* H. & A.) n. subvar.]

Rubus Canadensis Linn. Blackberry. This is the common Blackberry of the Keweenaw Peninsula and often is 7 or 8 feet or more high. The typical variety is sparsely prickly on the angles of the purplish stems. No. 184, August 22, 1884. Variety *Millspaughii* (Britt.) n. comb. is entirely unarmed and is the tallest variety. No. 183b, June 28, 1895. Variety *elegantulus* (Blanchard) n. comb. is copiously prickly on the angles and is the lowest variety. No. 3064, August 12, 1912.

Fragaria Virginiana Duchesne. Strawberry. The most abundant and widely dispersed of our native Strawberries. Cliff Mine, No. 65, August 31, 1883. Belle Isle, Nos. 65a, May 14 and 65b, May 27, 1893. Parkedale, No. 2546, May 19, 1912.

Algonac, No. 2719, June 16, 1912. Quite variable in shape of leaflets and character of pubescence. In the typical species the hairs on the petioles and scapes range from divaricate to loosely appressed, generally about horizontal; that on the pedicels is appressed. Fruit subglobose. Variety *Canadensis* (Mx.) n. comb. has the pubescence on the scapes sparse and subappressed, while that of the pedicels is more or less spreading; fruit smaller and more conical. Cliff Mine, No. 64, August 31, 1883. Detroit: Linden Park, No. 64a, May 14, 1901; Belle Isle, No. 1973a, May 24 and No. 1974b, June 16, 1906; Mack Avenue woods, No. 2020a, June 9, 1907. Algonac, No. 2720, June 16, 1912. Variety *Terrae-novae* (Rydb.) n. comb. has the pubescence on both peticles, and scapes sparse and subappressed. Cliff Mine, No. 3913, October 8, 1914. Detroit: Belle Isle, No. 65c, May 27, 1893. Variety *Illinoensis* (Price) A. Gray. A larger and coarser plant with the pubescence on the pedicels as widely spreading as on the petioles and scapes. Cliff Mine, No. 1732, August, 1901. Detroit, No. 1975½, June 18 and No. 1976b, June 20, 1906.

Fragaria vesca Linn. Differs from the preceding species chiefly in bearing the seed superficially on the smooth surface of the receptacle; in the other the seed is borne in sunken spots or pits. Cliff Mine, No. 66, August 31, 1883. Ypsilanti, No. 66a, June 13, 1891. A variation in which the receptacle is white is var. *alba* (Ehrh.) Rydb. Rochester, No. 2628, June 9 and No. 2748, July 28, 1912. Another variation with the pubescence of the scapes and often the petioles appressed as in the pedicels is var. *Americana* Porter. Cliff Mine, No. 739, July 7, 1890. Machinac Island, No. 739a, June 20, 1895. Marquette, No. 739b, July 6, 1895. Parkedale, No. 2650, June 9, 1912. Utica, No. 4181, June 6, 1916. Washington, No. 6204b, June 21, 1922. Oxford, No. 6518h, June 6, 1923.

Comarum palustre Linn. Purple or Marsh Cinquefoil or Marshlocks or Fivefinger. Frequent in swamps and peat bogs. The typical variety is non-glandular and is scarce. Cliff Mine, No. 400, June 30, 1886.

Comarum palustre Linn, var. *glandulosum* n. var. Peduncles and bractlets glandular villous, otherwise like the typical variety. Have previously reported this as var. *villosum* Pers.

Pontiac, Nos. 5264 and 5265, June 29, 1919. Eagle Harbor, No. 6633, June 29, 1923.

Potentilla intermedia Linn. Downy Fivefinger. Well established in Southeastern Michigan. In addition to places already reported I have found it at the following places: Island Lake, No. 1213b, July 16, 1905. Dead Lake, No. 2165, July 16, 1910. Portage Lake, No. 5839, June 12, 1921. Ypsilanti, No. 6220, June 28, 1922.

Crataegus exornata Sarg. Hawthorn. Thorn Apple. A low shrub of wet pastures, etc. Frequent in Keweenaw county. Cliff Mine, No. 1882a, October 4, 1904.

Crataegus borealis Ashe. A low shrub of rocky bluffs. Frequent in Keweenaw County. Probably belongs to the *Tenuifoliae*. Cliff Mine, No. 1882b, October 4, 1904; No. 117, June 30, 1884.

Gentiana alba Muhl. White Gentian. Flowers white. In low or moist grounds on Belle Isle, No. 1335, September 16, 1892. The most abundant form of this species has blue flowers and has been named *G. Andrewsii* by Grisebach. As it is only a color form it should be known as *Gentiana alba* f. *Andrewsii* (Griseb.) n. comb. Belle Isle, No. 1334, September 16, 1892. Rochester, No. 3529, October 5, 1913 and No. 4137, October 24, 1915. Parkedale, No. 3543, October 5, 1913. Ypsilanti, No. 4669, September 30, 1917. Marl Lake, No. 5706a, September 18, 1920. Orion, No. 4696, October 11, 1917. Algonac, No. 7277, October 15, 1924. Also on Squirrel Island, Ontario, No. 5679, September 16, 1920. In marly or gravelly grounds, the plants are reduced, usually to 6 or 7 inches in height, rarely one foot, with leaves an inch and a half long or less, blue flowers terminal only, usually one, occasionally two, rarely three. It may be known as *Gentiana alba* Muhl., var. *pauciflora* n. var. Algonac, No. 7277½, October 15, 1924. Sylvan Lake, No. 7281, October 22, 1924.

Gentiana clausa Raf. Allied to the above and very much like it, superficially. Reported as *G. Saponaria* Linn. Found only at Lakeville. No. 1750, September 2, 1901.

Asclepias incarnata Linn, var. *longifolia* A. Gr. A very narrow-leaved variety of the species from Texas and New Mexico. I place here a plant collected at Ypsilanti with linear-

lanceolate leaves well within the limitations given by Dr. Gray for this variety. No. 7061, August 20, 1924.

[*Lappula Redowskii* (Hornem.) Greene, var. *cupulata* (A. Gray) Jones. In the Bulletin of the Torrey Botanical Club, (1909) XXXVI, 676, Rydberb described *L. leucotricha* from Arizona and Utah. He referred to it, Rusby's No. 281 from Clifton, Ariz., April, 1881. The species is white flowered and the fruit not cupulate. In the herbarium of Parke, Davis & Co., the sheet bearing No. 281 of Rusby has two collections mounted thereon. One is from "sandy bottoms of cannons, San Francisco Mts., A. T., April, 1881." The other, evidently the same variety, comes from "Ash Fork, Ariz. T., in shade of Junipers, May 12, 1883." The flowers are blue and the fruit cupulate and of the heteromorphous condition. As the plants are erect, they fall to this variety. Arizona, as a general thing, is excluded from the range of variety *cupulata*, but Rusby's collections prove it should be included.]

Lonicera hirsuta Eaton. Honeysuckle. Leaves pubescent on both surfaces and ciliate. Outer surface of corolla glandular pubescent. Often climbing high to the tops of tall trees. *Caprifolium Douglasii* Lindl. (1830) is generally referred to this species. *Lonicera Douglasii* D. C., Prodr. (1830) IV, 332, generally referred here, at least in large part is *L. dioica* var. *Douglasii* and is the correct specific name of that variety when treated as a distinct species. Certainly De Candolle's description of glabrous petioles (*petiolatis glabris*), leaves pubescent beneath (*extus tomentosis*) exserted stigmas and included stamens, intensely green leaves (*folia intense viridia*) does not apply to *L. hirsuta*. The only part of the description that can apply to *L. hirsuta* is that referring to the ciliate leaves, and this can be construed either as an error or as a character to be excluded along with the plant from which the character was taken. Frequent in Keweenaw Co. Cliff Mine: No. 206, (high climber) May 30, 1885; No. 205a, (low, bunched mass of open fields) June 16, 1885.

Lonicera dioica Linn. Outer surface of corolla glabrous, leaves not ciliate, glabrous, glaucous beneath. Twining but never very high. Widely distributed over Michigan, but rather scarce. Copper Harbor, No. 205b, July 1, 1895. Highland

Park, No. 205d, May 7, 1896. Detroit in vicinity of Palmer Park, No. 1606b, May 26, 1898 and No. 3955, May 31, 1915. Also near the State line but on the Ohio side, near Alexis, No. 7296, April 15, 1925.

Lonicera dioica Linn, var. *Douglasii* (A. Gr.) n. comb. *L. Douglasii* D. C. largely; *L. parviflora* Lam., var. *Douglasii* A. Gr., Man. (1848) 171, 172; *L. hirsuta* Eaton, var. *glaucescens* Rydb.; *L. glaucescens* Rydb.; *L. dioica* Linn, var. *glaucescens* (Rydb.) Butters. When A. Gray published his var. *Douglasii* he gave a good description without quoting synonyms so that technically at least, it is not based upon either the *Caprifolium Douglasii* Lindl. or the *Lonicera Douglasii* D. C., but has a distinct and separate origin all its own; there is nothing in Gray's description to indicate *L. hirsuta* and his varietal name, being the oldest, must replace that of *glaucescens*. *L. Douglasii* D. C. pro parte, is the proper designation as a species. See under *L. hirsuta*. Usually low forming dense masses of twisting, curling stems. Leaves, not ciliate, green and glabrous above, glaucous and pubescent below, outer surface of corolla pubescent but not glandular. Much more abundant than the typical species. Cliff Mine: No. 205, May 30, 1885; No. 850b, July 2, 1895; No. 3066, August 22, 1912. Copper Harbor: No. 850a, July 1, 1895; No. 1612c, August 22, 1898. Eagle Harbor, No. 6615, June 29, 1923. Detroit: vicinity of Palmer Park, No. 205e, 1897; Belle Isle, No. 1907½, May 29, 1905; Mack Avenue woods, No. 2025½, June 23, 1907. Orion, Nos. 205c, May 30 and 917a, August 29, 1895. Parkedale, No. 2929, July 28, 1912. Metamora, No. 6649, July 18, 1923. Variety *Douglasii*, frequently shows a variation with pubescent and glandular ovaries and fruits and this may be known as subvar. *dasygyna* (Rehder) n. comb. Parkedale, No. 2690, June 11, 1912. Rochester, No. 3645, May 26, 1914. Detroit: vicinity of Palmer Park, No. 3956, May 31, 1915. Lakeville, No. 4912, June 2, 1918.

Achillea Ptarmica Linn. Sneezewort or Sneezeweed. An introduction from Europe. Waste grounds at Detroit, rare. No. 3554, October 15, 1913.

Achillea Millefolium Linn. Yarrow. Millfoil. An immensely variable species: caespitose or scattered, from nearly

glabrous to woolly, copiously branched or simple, leaves open and broad to narrow and close, corymbs flat topped to convex, the scales of the involucre vary from uniformly straw colored to almost uniformly brown. The typical form has rather small heads (1.5-2 lines high) with pale brown bordered scales. The rays are rather large, .75-1.75 lines broad. In fields and thickets. Lake Linden, No. 6597, June 25, 1923. Cliff Mine, No. 3913½, October 8, 1914. Eagle Harbor, No. 4005½, July 8, 1915. A variation with scales bordered a very dark brown is var. *nigrescens* E. Meyer. Copper Harbor, No. 4004, July 8, 1915. A variation with larger heads (3 lines high) having the scales bordered a very dark brown, the inner ones acute is var. *borealis* (Bong.) n. comb. (*A. borealis* Bong.) Very scarce in this region. Copper Harbor, No. 5968, August 16, 1921. Another variation, very woolly, with larger rays (up to 3 lines wide) and usually greenish yellow scales, unbordered, (rarely with a pale brown border) is var *lanulosa* (Nutt.) Piper. Occasional throughout the state. Washington, Nos. 6005 and 6006, September 14, 1921. Royal Oak, No. 5587½, August 12, 1920. Another variation has small rays (.5 to 1.25 lines wide) with narrower, more cylindrical heads, the scales uniformly straw colored and is var. *occidentalis* (Raf.) DC. This is the most abundant form of Yarrow in Michigan. Belle Isle, No. 431b, July 23, 1892. Rochester, No. 6970, July 16, 1924. Wayne, No. 7150, July 10, 1924. Erie, No. 6643, July 11, 1923. Romeo, No. 6192, June 21, 1922. Slocum's Island, No. 5985, August 31, 1921. Marl Lake, No. 5710, September 18, 1920. Rochester, No. 4584½, September 2, 1917. A form of var. *lanulosa* with rays from pale rose or pink to dark rose or magenta is *f. rubicunda* Farwell. Previously reported as var. *Asplenifolia*, var. *rosea*, and as A. *lanulosa* f. *rubicunda*. This is probably the *A. Millefolium* var. *rosea* Torr. & Gr., at least in part. Ortonville, No. 6189, June 14, 1922. Romeo, No. 6193, June 21, 1922. Rochester, No. 6932, July 2, 1924. Ypsilanti: No. 1162, June 27, 1891; No. 5288a, July 13, 1919; No. 6217½, June 28, 1922. (I have collected it at Longport, N. J., No. 5902, June 27, 1921. A specimen collected at Birmingham, Alabama, June 4, 1917, by Dr. J. P. Phillips, has the

ultimate leaf divisions ovate and otherwise fits in very well as var. *maritima* Jepson, of the San Francisco Bay region.)

Carpinus Caroliniana Walt. Ironwood. Hornbeam. Blue Beech. This is a small, bushy tree abundant in moist woods and thickets, and along river banks. Said to extend throughout the state, but I have not observed it in the Upper Peninsula. Belle Isle, No. 1273, July 23, 1892. Parkedale, No. 2941, July 28, 1912, and No. 3242, October 27, 1912.

Ostrya Virginiana (Mill.) C. Koch. Ironwood Hop Hornbeam. Similar to the preceding but easily distinguished by the fruits; in the former the bracts are separate but in this they are united to form an inflated sack. The fruiting catkin very closely resembles that of the Hop—hence one of the names. In dry or upland woods. The typical form of the species has pubescent *but not glandular* twigs. It is southern in distribution. Have not observed it in Michigan, which probably is too far north for it. Our plant belongs to the following variety.

Ostraya Virginiana (Mill.) C. Koch, var. *glandulosa* (Spach) C. S. Sarg. The twigs of the season, the petioles and the peduncles are more or less beset with stalked glands. This is the northern form of the species; in the far north the parts involved are densely glanduar; but in the southern part of its range the glands are few and scattered. On the Keweenaw Peninsula where this variety is abundant, the young growths of the season are very densely glandular and have a characteristically reddish sheen due to the red glands, if my memory serves me rightly. Keweenaw Co., No. 88, June 22, 1884; Detroit, No. 88a, August 12, 1899; Parkedale, No. 2730, June 23, 1912; Pittsfield, No. 6205b, June 28, 1922; Newport, No. 6235, July 5, 1922. Mr. C. A. Davis collected it at Alma, May 6, 1891. [In the herbarium of Parke, Davis & Company are two sheets: one with a specimen collected at Shelbourne, Mass., in 1875, by Miss S. E. Anderson; the other shows a specimen from the Torrey Herbarium, without data].

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THE STRUCTURE AND RELATIONSHIPS OF THE TRUE STROMATOPOROIDS[1]

GEORGE B. TWITCHELL

I.—INTRODUCTION

"There is no analogy, however faint, which may not be of the utmost value in suggesting experiments or observations that may lead to more general conclusions."—*John Stuart Mill.*

Reasoning by analogy may not be quite the orthodox manner to be used in reaching scientific conclusions, but to a very great extent paleontological conclusions have been reached in this manner and often cannot be reached in any other way; and this on account of the character of the material at our disposal. This does not apply to the more recent fossils for here our often quite exact knowledge has been obtained by a more complete induction.

Vertebrate paleontology has the advantage of commonly dealing with bones. We have a very correct knowledge of osteology. But even in vertebrate paleontology, especially when we are dealing with lower and older forms, problems arise that can only be tentatively solved, and then only by analogy.

Again in invertebrate paleontology conchology, founded on the easily studied modern shells, offers an excellent guide to the study of fossil shells. Other examples could be offered in which a strict orthodox induction has led to very exact conclusions; but there are an enormous number of fossils in which all we have to guide us in our studies are faint analogies with living forms. Here a paleontologist without a good imagination is lost.

Faint analogies should not be neglected. Their careful study often leads to the discovery of other analogies either

[1] Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 7.

strengthening or destroying the conclusion first suggested. The mind should be held open for either event for "analogy, as we know, is a good servant but a bad master; when master it does more to blind than it may previously have done to illuminate."

The stromatoporoids present a very good example of fossils whose place in the scheme of nature has been determined by faint analogy; an analogy that at times does not extend throughout the group for the stromatoporoids, as usually considered, make up a heterogeneous series of fossils probably belonging to widely different classes. Some may have been algae. Naturally different observers were impressed by different analogies and so these fossils were shunted from one biological group to another.

II.—HISTORICAL REVIEW

Goldfuss, who founded the genus *Stromatopora*, (Petrefacta Germaniae, Bd. 1, p. 21, 1826), gave it a place between the millepores and the madrepores; d'Orbigny, (Prodrome de Paleontologie, 1850), classed the stromatoporoids with the sponges, the Sandhegers, (Die Versteinerungen des rheinischen Schlichten systems in Nassau, p. 380, 1850-56), thought them bryozoans as did Roemer, (Lethaea Geognostica,[2] 3rd ed., vol. 1, p. 166, 1851-56), who later, however, classed them with the tabulate corals.

What Nicholson calls "one of the most important contributions to the study of Stromatoporoids" was published by Baron von Rosen in 1869 under the title "Uber die Natur der Stromatoporen, und über die Erhaltung der Hornfaser der Spongien in fossilen Zustande."

Baron von Rosen went beyond faint analogies and attempted by the means of microscopic study of thin sections to establish a more complete induction and thus find the proper affinities of the stromatoporoids. The splendid plates in his work deal largely with the minute structure of the skeleton. Baron von Rosen concluded that the stromatoporoids were horny sponges that had become calcified.

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[2] In 1883 in the second part of his Lethaea Palaeozoica Roemer placed the stromatoporoids among the Hydrozoa.

We may not accept, in its entirety, von Rosen's conclusion, but we must admit his methods of study were correct.

Stromatoporoids have been referred to sponges other than the *Ceratospongiae*. Salter, (Catalogue Silurian Fossils, p. 99, 1873), considered them calcareous sponges. In 1878 Nicholson and Murie published a paper on "The Minute Structure of the Skeleton of *Stromatopora* and its Allies," (Journ. Linn. Soc., vol. 14, 1878). In this paper they conclude from the then available evidence that the stromatoporoids may be best regarded as a separate section of the calcareous sponges, for which they proposed the name *Stromatoporoidea*. They did not establish any biological connection between the stromatoporoids and the recent calcareous sponges. This left the matter in a very unsatisfactory state for such a group would have to be founded solely on imagination without the help of analogy. Sollas, (Ann. Mag. Nat. Hist., ser. 4, vol. 19, 1877), placed the genus *Stromatopora* among the siliceous sponges, (Hexactinellida).

Before we come to the generally accepted idea of the hydrocoralline affinities of the stromatoporoids it should be mentioned that they have been classed even with the Foraminifera. Dawson in the "Dawn of Life" (1875) and later in a memoir on "The Microscopic Structure of the Stromatoporidae," (Quart. Journ. Geol. Soc., vol. 35, pp. 48-66, 1879), so considered them.

The idea that the stromatoporoids make up an extinct group of hydrocorallines is founded on analogies that do not extend throughout the group.

Carter, (Ann. Mag. Nat. Hist., 1873 and later), devoted a great deal of attention to the study of various species of *Hydractinia;* and as a result of this study became impressed with the similarity of the skeleton of *H. echinata* to that of *Labechia,* (following M. Heinrich *Labechia* is not recognized as a true stromatoporoid in this paper) ; to a lesser degree this analogy also extends to *Actinostroma,* (a true stromatoporoid) but here the analogy ceases.

The resemblance between *Labechia* and the various species of *Hydractinia,* recent and especially fossil, to me is very striking; Nicholson, however, after pointing out many dissimilar-

ities, concluded that "the resemblance between the *Labechiidae* and *Hydractinia echinata* does not appear to me to be nearly so close as it is in the case of the *Actinostromidae*," (Monograph of the British Stromatoporoids, p. 69). With this I cannot concur and even Nicholson admits that "it is only with a particular section of the Stromatoporoids, (*Actinostromidae*), that the likeness is at all very conspicuous," (Monograph of the British Stromatoporoids, p. 68).

The groves on the surface of a *Hydractinia*, (Plate XX, Fig. 2), are not homologous or even analogous to the astrorhizal canals of a stromatoporoid. *Labechia* has no astrorhizal canals.

The analogy of the stromatoporoids with *Hydractinia* proved insufficient to establish a hypothesis, but it lead to the discovery of other analogies.

Millepora, largely on account of its porous coenosteum, was looked upon as presenting a structure analogous, if not homologous, to many of the stromatoporoids.

Millepora has tabulated zooidal tubes, and consequently such tubes, to make the analogy complete, had to be found in stromatoporoids. Little advance would be made in science without the use of working hypotheses: but there is always danger that enthusiasm for the hypothesis may lead to the unconscious manufacture of evidence in its support.

Carter, (Ann Mag. Nat. Hist., ser. 5, vol. 2, p. 304, 1878), suggested that caunopora tubes housed polyps and were comparable to the gastropores of *Millepora*. Vertical sections through *Millepora* including gastropore tubes and vertical sections through a stromatoporoid including caunopora tubes, (Plate XIX, Figs. 4-5), often present a most remarkable similarity; a similarity as striking as that of *Favosites* to a honeycomb, but the analogy is as faint in one as the other.

Carter did not long hold to this view; in a paper, (Ann. Mag. Nat. Hist., ser. 5, vol. 1, p. 339, 1880), he described a stromatoporoid from Devonshire having tabulae in the branches of the astrorhizae. These tubes he considered similar to the tabulate tubes of *Millepora*. His conclusion that the millepore zooid emerged from the astrorhizal canals, probably, I suppose from the astrorhizal centers, did not receive recognition.

I believe it can be demonstrated that the structures described by Carter are not tabulae; but even so, if the stromatoporoids were hydrocorallines, these astrorhizal centers and cylinders would be the only places in the coenosteum from which polyps could emerge: then the astrorhizal canals would be the coenosarcal tubes. An idea hardly to be accepted.

Nicholson, (Monograph of the British Stromatoporoids), rejecting Carter's conclusion, described what he thought to be the zooidal tubes needed to establish the coelenterate affinities of the stromatoporoids.

Vertical sections of the various species of *Stromatopora* present pictures strongly suggesting that the stromatoporoid was made up almost entirely of tabulate tubes. Nicholson discusses this at length and concludes that these sections demonstrate the presence of the required zoöidal tubes.

But they are not tubes; what is seen in the section are the open spaces between pillars. G. Steinman in 1903, (*Milleporidium*, etc.), strongly questioned the existence of the so-called "zoöidal tubes," and even the conservative Parks, (Silurian Stromatoporoidea, 1909), looked upon them with doubt.

We are really left in the same position as when Nicholson wrote: "The great difficulty which many observers have felt in the way of accepting the reference of the stromatoporoids to the *Coelenterata* is that no clear demonstration had been made of the existence in the skeleton of any tubes which might have lodged the zoöids of a Hydrozoan or Actinozoan colony. It was this difficulty which induced me previously to adhere to the reference of the group to the *Rhizopoda*." (Monograph of the British Stromatoporoids, p. 49.)

Nicholson's Monograph left the question of the stromatoporoid affinities in an unsatisfactory state, but did establish a generally satisfactory working classification. He included in the group many fossils that later study will probably relegate to other groups, and many of his interpretations of structure will be modified or entirely discarded, but many years will pass before this Monograph will cease to be indispensable to the student of stromatoporoids.

In 1907-1910 W. A. Parks, (University of Toronto Studies,

Nos. 4-7), published a series of studies of the stromatoporoids of the Guelph in Ontario, the Niagara, the Silurian of America and the Ordovician. In general his ideas adhere very closely to the teaching of Nicholson; here and there, however, throughout his papers a doubt as to the correctness of the accepted plan of architecture is suggested, but no better plan is proposed, nor is any effort made to limit Nicholson's heterogeneous assembly by excluding from the group organisms that may be far removed from the real stromatoporoids.

The work of Parks is very valuable in putting on record new species, providing more material for generalization. Parks, in these papers, found three new genera, *Dermatostroma, Aulocerium* and *Actinodictyon.* The first two are not true stromatoporoids but possibly related to *Labechia;* the third, a true stromatoporoid, will prove valuable in the discussion of structure.

Among the publications, limited to single genera or species, here and there will be found one in which the genus or species is removed by the author from the stromatoporoids considered as a hydrocoralline group.

Raymond, (Bull. Victoria Mem. Mus., 5, p. 8, 1914), described a fossil (*Cryptophragmus antiquatus*) from the Black River as an alga. This fossil seems to be the chambered inner tube of a *Beatricea* common in the upper Richmond. Shideler, in a paper read before Section E of the American Association for the Advancement of Science, 1919, offered strong presumtive evidence that the chambered inner tubes of *Beatricea* are plants. He described what he concluded were "fruiting bodies." Shideler's opinion is that *"Beatricea"* is a chambered alga with a stromatoporoid, (to which he restricts the name *Beatricea*), growing on it. This stromatoporoid grows also on *Stromatocerium* and other objects; it may be identical with *Aulocerium* Parks. In 1865 Hyatt, (Amer. Journ. Sci. and Arts), expressed the opinion that *Beatricea* belonged to the Cephalopoda.

Aside from this work on *Beatricea,* (althcugh here and there it was suggested that the stromatoporoids were not a natural group), little was done to find definite affinities for

individual genera and no critical examination made to find how the varicus organisms could be related to one another. Hydrocoralline affinities were assumed for all.

In 1914 M. Heinrich, (N. Jahrb. für Min. etc., No. 23, pp. 732-36, 1914; translated by Clara Mae LeVene, Journ. Geol., vol. 24, p. 57, 1916), in a paper on the Structure and Classification of the Stromatoporoidea, greatly simplified the entire problem by selecting from the hodge podge of fossils called stromatoporoids a group of closely allied genera which he called the "true stromatoporoids."

The discussion to follow will deal entirely with Henrich's true stromatoporoids and leave for future consideration the many excluded genera.

III.—CAUNOPORE TUBES

Certain peculiar structures, the caunopore tubes, are commonly associated with stromatoporoids. The history of the various ideas that have been held as to their nature is closely associated with the history of stromatoporoid study.

A digression may be here permitted to take up this matter for with their elimination as integral parts of stromatoporoids they will find no place, aside from an ecological suggestion, in a theory of structure to be offered in this paper.

In 1841 Phillips, (Pal. Foss. of Cornwall, 1841), founded the genus *Caunopora* for two species of fossils *C. placenta*, (*Coscinopora placenta* Lonsdale), and *C. ramosa* Phillips; *C. ramosa* is now recognized as belonging to the genus *Amphipora* Schulz. *Amphipora* is not a true stromatoporoid according to the Heinrich definition recognized in this paper.

The generic name *Caunopora* has given rise to the term caunopore tubes, (Caunopora tubes of Nicholson). These tubes are most common in species of *Stromatopora* and *Stromatoporella;* but they are also to be found in other genera. Bargatzky, (Die Stromatoporen des rheinischen Devons, 1881), gave the generic name *Diapora* to the tube bearing stromatoporoids of these other genera, i. e., to the genera of colonies in which the tubes are included in a mass made up of concentric laminae and distinct radial pillars.

The typical caunopore tubes are usually thick walled with an internal cavity narrowed or nearly obliterated by a light colored dense deposit. The walls may be thin and the secondary deposit scant or absent. The tubes are often tabulate. The tabulae may be straight, curved or funnel shaped; so-called vesicular tabulae are not uncommon. Caunopore tubes with septal spines have been described. In general the tubes arise from irregularly horizontal stolons and extend at right angles through the laminae of the entire mass to open at or slightly above the surface. The vertical tubes may give off branches to communicate with neighbors or bend upward to form new vertical tubes. The vertical tubes are often very regularly spaced throughout the entire stromatoporoid or arranged in colonies; single, isolated branching tubes, however, are not uncommon.

Nicholson, in a Monograph of the British Stromatoporoids devotes a chapter to "The Nature of Caunopora." In this discussion he presents three theories "(1) The view that *'Caunopora'* and *'Diapora'* are genera of Stromatoporoids; (2) the theory of Roemer that *'Caunopora'* and *'Diapora'* are the result of the commensalism of certain Stromatoporoids with certain corals; and (3) the theory that the 'tubes' of *'Caunopora'* and *'Diapora'* belong to the organism in which they are found, but that they represent structures which are only developed in certain colonies or in certain individuals, and that these names, therefore, merely indicate a *state* of certain Stromatoporoids."

Nicholson in discussing the first theory offers what seems to me conclusive proof of its untenability. The genus *Caunopora* is still recognized, however, if but in a half-hearted way for we read in Zittel, (Text-Book of Paleontology, 2nd ed., vol. I, p. 123, 1913): "In other cases, however, the tubes appear to have been formed by true Stromatoporoid polyps." It is strange how long it takes to bury a dead idea.

The third theory seems also to have some adherents. A recent author, (Parks, Niagara Stromatoporoids, Plate 7, Fig. 8, 1908), speaks of "*Caunopora* States." There is no similarity between caunopore tubes and the tabulated tubes of

Idiostroma, Stachyodes and *Amphipora.* These three genera, however, are not "true stromatoporoids." It has been suggested that the tubes lodged reproductive polyps—pop guns for shooting out the pseudo-medusae of milleporoids. The very oddity of the idea is attractive. We like to make strange creatures out of the animals of the past.

The second theory, the commensalism theory of Roemer, I shall discuss more fully for it naturally leads to what I believe to be the true explanation.

As a rule commensalism among fossils can only be inferred. The constant close association of two species of different families may be considered strong presumptive evidence. A striking example of such association is found in the Ordovician bryozoan *Leptotrypa ornata* and the gastropod *Cyrtolites ornatus.* The bryozoan is found on this gastropod and nowhere else. According to Ulrich nine out of ten of these shells, in the Corryville of the Cincinnatian, are covered with the bryozoan. Whether these shells were living or dead when the bryozoan growth occurred we do not know. *Hydractinia* covers dead gastropods which are inhabited by hermit crabs. If commensalism exists, as is usually presumed, it exists between the hermit crab and the *Hydractinia;* not the gastropod and the *Hydractinia.* We can only speculate when we consider Ordovician commensalism.

Fossil bryozoans encrust other bryozoans, crinoid stems, corals, cephalopods, etc., and each species, or at least each genus, seems often to have a particular choice, selecting over and over again the same organism to encrust, but this is far from commensalism.

Corals and hydrocorallines, fossil and recent, encrust and even totally envelop other organisms. Encrusting forms often have as well developed epithecae as do the apparently free forms; so encrusting is probably, in most cases, an accidental environmental condition.

The encrusting and enveloping of foreign organisms is as common with the stromatoporoids, (Plate XX, Figs. 3-4), as it is with corals and bryozoans; but there is in the stromatoporoids an enveloping that goes beyond what occurs in colonies of corals or bryozoans. The connection between the

stromatoporoids and the enveloped organism is much more intimate, so intimate indeed as to have given rise to the idea that the enveloped organism was an essential part of the stromatoporoid.

In colonies of corals or bryozoans it is essentially the base that is in contact with the foreign body. The base or epitheca of a stromatoporoid is frequently very small so that an enveloping, rather than an encrusting, occurs. The walls of polyps or zooids may be closely applied to a foreign body enveloped in the coenenchyma but in the stromatoporoids the foreign body, caunopore tube, is actually in the living chamber for interlaminar spaces, as we shall see later, may be looked upon as essentially living chambers of sponges. It is not strange that symbiosis or at least commensalism should have been suggested as an explanation of this condition.

Readily recognized corals, (Plate XX, Fig. 3-4), are often enveloped by stromatoporoids in the same way that caunopore tubes are enveloped; typical caunopore tubes often have an internal structure strongly suggestive of *Aulopora* and *Syringopora*, but not to my knowledge of recognized species of these genera. Roemer in his theory of commensalism finally looked upon *Aulopora* as the important commensal.

Even the typical caunopore tubes, (Plate XVIII, Fig. 3-5), are not always like *Aulopora* or *Syringopora*. A tube, or colony of tubes, without tabulae or septal spines and nearly closed with light colored parenchyma, if found unassociated with a stromatoporoid would in all probability be considered a fossil alga. Even more suggestive of algae, (Plate XVIII, Fig. 1), are delicate organisms, almost walless and dichotomously or monopodially branching, that are enveloped by the stromatoporoid precisely as are the typical tubes. Such alga-like forms are not very uncommon, (Plate XVIII, Fig. 1).

If we consider commensalism as the *raison d'etre* of "caunopora tubes" we must look upon the stromatoporoids as very generous and broad-minded, receiving as partners corals, bryozoans, worms and algae. No sharp line can be drawn between the tubes of the genera *Caunopora* and *Diapora*, and the great variety of isolated tubes found in stromatoporoids everywhere.

Perhaps we may infer commensalism in some few instances, but to me the more logical explanation is that the stromatoporoids in life had a delicately growing structure readily encompassing neighboring organisms without distorting them in any way and perhaps preserving some that under other conditions would be entirely lost. Only a very few fossils that closely resemble caunopora tubes are found in the stromatoporoid bearing rocks. These are easily preserved corals.

The delicate growing tissue of a sponge later reenforced by spicules is especially adapted to envelop and preserve neighboring organisms, (Plate XXVI, Fig. 1). The structure of a sponge is such, that included foreign bodies can extend through the entire mass and be very intimately associated with it, without in any way affecting its economy. As a sponge grows even a paragastric cavity can be formed with a foreign body, lined of course with sponge tissue, in its center, (Plate XIX, Fig. 1 and Plate XVIII, Fig. 4). In a broad sense the paragastric cavities, as we shall see later, analogous to the interlaminar spaces of stromatoporoids, are the living chamber of sponges.

This very intimate association of different organisms, without any suggestion of commensalism, is common among fresh water sponges and bryozoans, (Plate XVIII, Fig. 2). The best way to find the delicate little bryozoan *Pottsiella erecta* is to hunt for encrusting sponges especially *Trochospongilla*. The living bryozoan will be found piercing the sponge. Other bryozoans will then be found on the rocks about the sponge. The locality was favorable for the growth of either.

Of course, this is not the only bryozoan that may become enveloped by sponge growth. Algae are also frequently included.

According to Parker and Haswell, (Text-Book of Zoology vol. 1, p. 127, 1910), the same conditions of life are to be found in marine sponges. "Frequently a Sponge and a Zoophyte grow in intimate association, so that they seem almost to form one structure. Sponges often also grow in very close association with certain low forms of plants (algae)."

With the exception of plants, especially fungi, sponges are the only modern forms of life that include foriegn organisms in any way analogous to the inclusion of caunopore tubes in stromatoporoids.

The ecological implication presented in this digression may not be entirely convincing, but it serves to present my thesis that the true stromatoporoids were sponges.

IV.—HEINRICH'S DEFINITION

M. Heinrich, with very good reasons, excluded from the stromatoporoids the genera *Amphipora, Stachyodes, Idiostroma, Labechia, Rosenella* and *Beatricea*. Exclude these genera and we have a group of very closely allied fossils.

Heinrich still adheres to the Nicholson classification recognizing the two families *Actinostromidae* and *Stromatoporidae*, but not as hydractinoid without and milleporoid with tabulated zooidal tubes; for with Heinrich zooidal tubes analogous to those of *Millepora* do not exist. The distinction that Heinrich makes between his two families lies in the structure of the fibres. The *Stromatoporidae* have non-massive, (porous or perforate), fibres. The *Actinostromidae* have massive fibres. This structure will be more fully discussed later.

The two families that Heinrich makes may or may not be natural divisions, but what he calls the "true *Stromatoporoidea*" surely make up a natural group.

Heinrich offers the following definition of the "true *Stromatoporoidea*": "The skeleton is built up of seamlessly united, massive or porous calcareous fibres, which form a more or less regular network. In this can be recognized a more or less plainly layered arrangement of the tangential elements. Astrorhizae are always present." This last sentence is of vital importance, for a study of the astrorhizae or better of the astrorhizal systems, will show that all of these stromatoporoids are built upon one definite general plan. This plan is also the plan of the simplest form of rhagon sponge.

V.—THE ASTRORHIZAE

Stromatoporoids are often covered with tracings, making designs that add beauty to otherwise unattractive fossils.

These are the astrorhizae. They are not always visible on the surface; sometimes they are lost in weathering and sometimes are covered with what is called a dermal layer. Possibly they are only visible when this layer has been lost by weathering or destroyed before fossilization. When they are in evidence they assume very characteristic forms.

As seen on the surface of a stromatoporoid the astrorhizae present groups of meandering canals. These groups, they may be called colonies, cover the entire upper surface. The canals of each group radiate from a center like rootlets from a central stem, hence the name; the center, however, is actually like the canals, an open space. The canals, like rootlets become smaller and smaller as they leave the center; in their course they communicate with each other and finally inosculate with the terminal branches of adjoining astrorhizae, (Plate XX, Fig. 6.).

The astrorhizae on the surface of a stromatoporoid are often more or less covered with a dermal layer. In well preserved specimens of *Stromatoporella granulata* this layer is very distinct. Often the layer seems imperforate, but in *S. granulata* it is pierced with numerous small pores, (Plate XXII, Fig. 6); this is probably the normal condition in life; pores are easily lost in fossilization. The entire dermal layer may be lost in fossilization. It is hardly likely that, except through accident, one stromatoporoid should have a dermal layer and another, in every other way of similar structure, should be without what seems an important element. Stromatoporoids with an astrorhizal system hidden by a dermal layer retain an opening that can be shown by grinding to be an astrorhizal center.

Nicholson, following Carter, considered the astrorhizae analogous to the coenosarcal grooves on the surface of *Hydractinia* and the inosculating canals of *Millepora*. In the hydrocorallines coenosarcal tubes establish a connection between the polyps but do not radiate from a center as do the astrorhizal tubes. In the astrorhizae the center is the important element of the system, the tubes become more and more indistinct and smaller as they leave it. The coenosarcal tubes of *Millepora*

or *Hydractinia* are of practically uniform size throughout, (Plate XX, Figs. 1-2). This is the weak point in Nicholson's analogy. Nicholson's own figures in his Monograph show this very plainly.

It is not in the hydrocorallines that structures analogous to astrorhizae are to be found.

Sponges have structures in every way analogous to the astrorhizae of stromatoporoids. This is most distinct in those fresh water sponges that have the simplest form of rhagon structure. All that has been said of the astrorhizae of stromatoporoids will correctly describe the astrorhizae of these sponges, (Plate XX, Fig. 5).

Just as in the case of many and probably all stromatoporoids, the astrorhizae of sponges are covered with a perforated dermal layer. This is so thin that the astrorhizae can be seen through it, (Plate XXII, Fig. 4). At the center of an astrorhizal system is an osculum uncovered by the dermal layer.

Astrorhizal systems occur in each layer as we go down through the mass of the stromatoporoid. Of course below the surface they are always covered and become tunnels. Just as in the astrorhizae on the surface, the tubes are largest and most distinct at the centers. At the periphery where the system inosculates with adjoining systems the tubes become lost in a maze of the pillars of an interlaminar space.

At the center of each of these covered astrorhizal systems, is an opening, (Plate XXI, Fig. 1). When, as is often the case, the astrorhizal systems of the different layers are superimposed, this opening becomes the common orifice of a number of astrorhizal systems from as many interlaminar spaces. Nicholson in describing this arrangement uses the term "astrorhizal cylinder," (Plate XXII, Fig. 5). When the astrorhizal systems are not superimposed a large astrorhizal branch, like the stolon of a strawberry plant, branches off to connect with the center of another system of a lower level, (Plate XX, Fig. 7). This condition is not always easy to demonstrate, usually the grinding of many sections is required for the purpose.

In the more delicate species, such as *Clathrodictyon vario-*

lare, the astrorhizal plan can only be determined by the study of sections; but in coarser forms, such as *Stromatopora monticulifera*, a hand lens is sufficient to show the entire structure in horizontal fractures, as these naturally follow the weak, open, interlaminar spaces. Such a fracture will show the tracings of the astrorhizal canals on both upper and lower surfaces, and between the canals and beyond their limits, projections produced by the pillars, now broken, that connect the laminae, (Plate XXI, Fig. 2). All of the spaces between the pillars are in free communication with each other and are indeed nothing but the ultimate ramifications of the astrorhizal canals. The whole arrangement may be likened to a field of stumps through which pass winding and branching roadways.

The astrorhizal canals have no well developed walls except perhaps where they converge to a center that communicates with the outer world.

In addition to the large openings at the confluence of astrorhizae the laminae have innumerable pores, (Plate XXI, Fig. 4). They are not always easy to recognize for they are often closed by mineralization; but when they are distinct it becomes apparent that they also connect the interlaminar spaces with the external world. They are analogous to the incurrent canals or ostia of sponges; then the astrorhizal canals would be analogous to excurrent canals converging to a central paragastric cavity.

The more or less constant arrangement in layers indicates a certain periodicity of growth upward, while the lateral growth may be continuous. Each layer includes a number of astrorhizal systems. Each system makes up a biological unit. These units are in communication with each other: laterally by the intermingling of the ultimate ramifications of the astrorhizal canals, vertically by the astrorhizal cylinders or stolons.

When so considered the definite general plan suggested becomes apparent, for it is the arrangement of these biological units that is constant throughout both milleporoid, (*Stromatoporidae*), and hydractinoid, (*Actinostromidae*) groups.

If what I have designated the biological unit of a stroma-

toporoid be considered by itself, we see in it the structure of a rhagon in which the paragastric cavity has become modified resulting in the formation of pillars and astrorhizal canals. When this modification, (the result of folding), is slight a vertical section will show a very close approach to the theoretical idea of a primitive rhagon, (Plate XXII, Fig. 3).

VI.—THE RHAGON

A simple rhagon has large paragastric cavity opening to the exterior by an osculum. Over the entire upper surface, about this osculum as a center, are numerous ostia—the open-

Fig. 1

FIG. 1.—A diagramatic section of a simple rhagon sponge. O, osculum; P, paragastric cavity; ciliated chambers open into the paragastric cavity by exhalant pores, (apopyles). Inhalant pores, (prosopyles), not shown. (After Keller, from Minchin.)

ings of incurrent canals which communicate directly with the ciliated chambers; from these chambers the excurrent canals pass into the paragastric cavity. "In the *Rhagon* proper the arrangement of parts is very simple. The Sponge has a paragastric cavity opening on the exterior by an osculum. Opening into this central cavity by wide apopyles are a number of rounded chambers, each communicating with the exterior by an inhalant pore (prosopyle)." (Parker and Haswell, Text Book of Zoology, vol. 1, p. 119, 1921.)

The ideal rhagon does not exist as an entity in nature; but certain of the fresh water sponges approach it very closely,

(*Spongilla and Trochospongilla*). These sponges have a structure very like that of many of the stromatoporoids and vary from the ideal of a simple rhagon in much the same way that the stromatoporoids do.

A unit of *Spongilla fragilis*, (Plate XXII, Fig. 4), varies from the simple rhagon plan by having the whole sponge, except at the osculum covered with a delicate dermal layer held up by spicules like tent poles. This establishes a subdermal cavity above the true ostia, i. e., above the true rhagon. The rhagon itself is no longer made up of a simple paragastric cavity lined with ciliated chambers; folding has differentiated

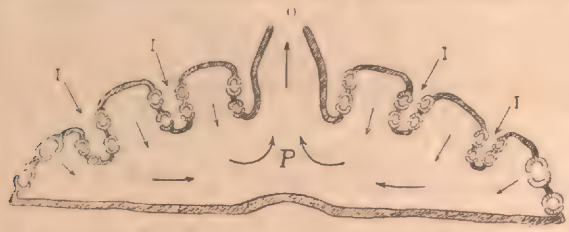

Fig. 2

FIG. 2.—Diagramatic section of a rhagon in early stages of folding. O, osculum; P, paragastric cavity; I, inhalant tubes; exhalant tubes open into the paragastric cavity.

the cavity into large excurrent tubes and cavity much after the plan of a stromatoporoid astrorhizal system even to the extent of forming definite pillars. The resemblance between the pillars about a paragastric cavity in the sponge and those about the cavity of a stromatoporoid is very striking, (Plate XXII, Figs. 1-4).

It may be hard to understand how folding can produce some of the complicated patterns of tubes, excurrent and incurrent, found in many sponges. A study of the simpler forms of folding as exhibited in *Spongilla* and indeed in the stromatoporoids will help solve this problem. The first result of fold-

ing in a rhagon is to increase the area of the surface which carries ciliated chambers; later the paragastric cavity is limited to a space no longer lined with ciliated chambers; the larger of the astrorhizal tubes in *Spongilla*, (Plate XXI, Fig. 3), are also not lined with ciliated chambers and may be considered either extensions of the paragastric cavity or extensions of the excurrent tubes. The ciliated chambers are to be found among the smaller tubes lost in the maze of pillars about the periphery of the true paragastric space.

The folding in of the choanosome of a rhagon producing the astrorhizae and pillars of a *Spongilla* or a stromatoporoid would naturally leave on its surface marks of a negative folding often simply in the form of depressions over pillars; the incurrent tubes are formed by this negative folding.

The tracings seen of a negative folding might be called negative astrorhizae. They may consist of small pores entirely covering a surface of a section without any definite design, (Plate XXI, Fig. 4), or arranged in patterns that have been described as astrorhizae; a careful study of the specimen producing them will always also show true astrorhizae. This will explain the different appearance of horizontal sections at different levels. At times, though rarely, the astrorhizae seen on the surface of a stromatoporoid are negative astrorhizae. The surface of a *Clathrodictyon* is covered with small vermiculate grooves, (negative astrorhizae), under which true astrorhizae can be demonstrated by section.

The essential difference between negative astrorhizae and true astrorhizae is that the true astrorhizae communicate directly with the paragastric cavity. A folding will leave indentations both above and below the folded surface of a rhagon. This surface has an opening, the osculum, (O. of Fig. 2), which is not affected by the folding, while the numerous small pores, prosopyles, are carried down by each fold that encroaches upon the original simple paragastric cavity. The spaces between the folds dipping down into the paragastric cavity form canals which, through the cavity, communicate with the osculum. On the surface of the rhagon the depressions caused by folding do not extend quite to the osculum, (Fig. 2).

Negative astrorhizae are smaller than the true ones and form less distinct canals because of the character of the folding; they may be simply small pores easily lost in mineralization.

In *Clathrodictyon cellulosum* and *C. striatellum* folding is very distinct. The open triangular-shaped spaces shown in the vertical sections, give the appearance of pores in horizontal section. It is evident that a horizontal section just below the upper lamina, demonstrating negative astrorhizae, would give a very different picture from that produced by a section just above the lower lamina passing through the true astrorhizae, (Plate XXVI, Figs. 3-4-5).

The formation of pillars in *Clathrodictyon* has been described as a folding by both Nicholson and Parks who do not recognize any connection between sponges and stromatoporoids.

VII.—MODIFICATIONS OF THE RHAGON STRUCTURE

The paragastric cavities of stromatoporoids so far considered have been of a primitive rhagon type; but this is not always the case, notably, in some species of *Actinostroma*.

In Nicholson's classification, the family *Actinostromidae* included the genera *Clathrodictyon*, *Actinostroma* and *Stylodictyon*.

Actinostroma has continuous pillars, i. e., pillars passing through several laminae, while *Clathrodictyon* has pillars limited to one interlaminar space.

The genus *Actinostroma* cannot be so lightly defined if we give to the astrorhizal systems the importance which I believe they should have. In some species of this genus the plan of the astrorhizal systems is such as to suggest that the growth is *Clathrodictyon*—like except for the continuous pillars; the mass is made up of thin units placed one on top of another. Some species have astrorhizal cylinders that have the structure of the cylinders, (columns of Nicholson and others), of *Stylodictyon;* while in one species at least the paragastric cavity approaches closely in form that of the modern sponge *Chalina*.

The species in question is a undescribed form of *Actinos-*

troma from the Niagaran. In it the paragastric cavity, (Plate XXIII, Fig. 6), consists of a branching tube extending down into the stromatoporoid. The walls of this tube are inflected making ridges, trabeculae, into the lumen; these are set at various angles. The branches have practically the same diameter as the main tube. Excurrent canals from the interlaminar spaces communicate with the tube, (paragastric cavity), at all levels. We have more precisely the arrangement of the paragastric cavity of the marine sponge, *Chalina arbuscula*, (Plate XXIII, Fig. 5).

In addition to this similarity it will be noticed that the spicules of *Chalina* are arranged on the plan of the pillars and laminae of *Actinostroma*. It was this structure of the pillars and laminae of *Actinostroma*, (Plate XXIII, Figs. 5 and 6), that led Nicholson to admit that the arrangement of pillars and laminae of some stromatoporoids did suggest a spicular meshwork.

A lamellar form of growth does exist in *Astinostroma* but it is often difficult to determine the exact limits of the lamellae. The laminae are usually not plates but arms extending from the pillars like spokes from a wheel. They are often double but even this does not always seem to mark the limits of lamellae. The resemblance of *Actinostroma* to *Chalina* might suggest that no lamellar structure existed in the stromatoporoid but this is not true.

VIII.—THE LAMELLAR STRUCTURE

In the stromatoporoid, as in the sponge, each osculum may be considered the center of a unit that is in intimate association with all surrounding units; in the stromatoporoid, however, the connection between units is much simper than in most modern sponges; there is a reguarity about it that does not seem sponge-like. This is especially true of the lamellar structure. So far as I know there is but one sponge, the fresh water *Trochospongilla leidyi*, that is built on this plan.

Potts, (Fresh Water Sponges, a Monograph. Philadelphia, 1887), in commenting on Dr. Bowerbanks' original description of *Trochospongilla leidyi* presents the following—"*Persistent;* the growth of successive seasons forming as many series of

thin laminae. Surface even, sometimes rising into smooth rounded prominences, and at times covered with singular radiating or bird-track-like markings, whose cause is not fully understood. Pores and osteoles numerous, minute; the latter being found along the radiate lines, but not conspicuous at their confluence. Texture very compact; composed of short spicules, very slightly fasciculated; the primary lines and principal channels nearly perpendicular; with single intercalating spicules forming polyhedral interspaces."

The outer layers of *T. leidyi* retain the spicular structure just described but the lower layers are so crowded with statoblasts that it is largely lost.

The "plainly layered arrangement" of stromatoporoids indicates the periodicity of growth previously mentioned. A periodicity of growth does not mean that the new layer alone contains the active living elements as may be the case in other organisms growing periodically. The intimate association of all units with each other would suggest that all alike retained their vitality. This is true of the laminar sponge *Trochospongilla*. This being the case we must not always expect to find sharp boundaries between the layers.

A periodical growth is limited to the thickness of the astrorhizal systems spread out in one place. These limits are often sharply marked by what may well be called laminae; but where the horizontal elements are discontinuous or curved several may exist in the thickness of a lamella, so that we must look to the arrangement of the astrorhizal tubes for a guide to the limits of periodic growth.

The limits of a period of growth even where the arrangement of horizontal astrorhizal tubes is distinct, cannot always be definitely determined but is often suggested by a difference in the structure along a certain level. There may be a layer of crowded laminae separated by small irregular spaces differing from the spaces produced by the ramifications of the astrorhizal tubes, or the laminae may be distinctly double.

The dermal layer of *Trochospongilla horrida* is thick and made up of layers of closely approximated spicules arranged horizontally. They are bound together by a minimum of or-

ganic material. In sections this layer appears distinctly double, (Plate XXII, Fig. 2).

Had *Trochospongilla horrida* the habit of periodic growth like its cousin *T. leidyi,* laminae would be formed throughout its mass and these laminae would be double, like those often seen in species of *Actinostroma* and at times in other genera.

It is altogether likely that in the stromatoporoids the dermal layer was often preserved in fossilization and in the fossils, as we now see them, served to show the limits of periodic growth.

The founding of a lamellar structure on indefinite plates, (laminae), has led to much misunderstanding of the architecture of different genera of the true stromatoporoids. Perhaps the most notable of such misconceptions occurs in the recognized definition of the genus *Stromatopora,* the genus whose name gave a name to the group.

Nicholson, in his description of the genus *Stromatopora,* says: "Concentric laminae are usually very imperfectly developed. The growth is very commonly by latilaminae, the radial pillars being continued from the top to the bottom of each latilamina."

A latilamina, as defined by Nicholson, is made up of a series of laminae and interlaminar spaces or better lamellae. A lamella is made up of a number of units in one plane. These units after spreading in one plane develop a similar growth above the first layer, then above the second and so on until a series of lamellae is formed. A change in the environment would cause a cessation of growth. Later through a regeneration, another series of lamellae would be superimposed. A number of such series often go to make up a stromatoporoid. These are the latilaminae.

Interesting as this regeneration may be, it is not a matter of vital importance in the structure of the organism. Many of the trepostomatous bryozoans have a similar mode of growth. A large example of *Amplexopora filiasa* is distinctly latilaminate.

In the genus *Stromatopora* an astrorhizal system is not spread out flatly through a shallow layer but branches irregu-

larly through a rather thick interlaminar space, not a latilamina. As Nicholson notes "pillars more or less broken extend from the base to the top and laminae are not distinct." The break between latilaminae, *sic*, in *Stromatopora* is no more distinct than the break between ordinary laminae. A latilamina in *Stromatopora* is simply a thick lamina or better lamella.

The term latilamina should be dropped entirely and lamina should be used only to designate plates, which may or may not limit lamellae. In this paper and in descriptions of stromatoporoids to follow the term lamella will be used in describing the layers of units that go to make up a stromatoporoid.

IX.—TRABECULAE

Stromatopora is the genus in which "tabulate tubes" are most apparent and on which Nicholson founded his idea of the hydrocoralline affinities of the group. Vertical sections do suggest the presence of tabulated tubes, but cross sections show that what appear to be the walls of tubes are in reality pillars. This alone should rule out the tube idea.

In some species of *Stromatopora*, (notably *S. antiqua* and *S. typica*), vertical sections show delicate granular lines horizontally crossing the spaces between pillars at quite regular intervals. These lines are frequently crowded, leaving but little space between them. In other species, not of *Stromatopora* alone but even of such a genus as the "hydractinoid" *Actinostroma*, what appear to be identical structures take very irregular courses. They cross the open spaces between pillars, and the astrorhizal canals at all angles. In *Stromatoporella*, (Plate XXIII, Fig. 2), they are particularly abundant in the astrorhizal cylinders, where they are identical in appearance with the trabeculae in the osculum of the modern sponge *Chalina*, or *Aplysina*, (Plate XXIII, Figs. 1 and 5).

I am inclined to consider these structures trabeculae of the astrorhizal canals. In some instances they are bars crossing a canal. This may be the case in the delicate lines crossing the pseudo-tubes, (really downward projections of the astrorhizal system), in *Stromatopora typica*. Very frequently they are ridges projecting into the lumen of an astrorhizal canal or

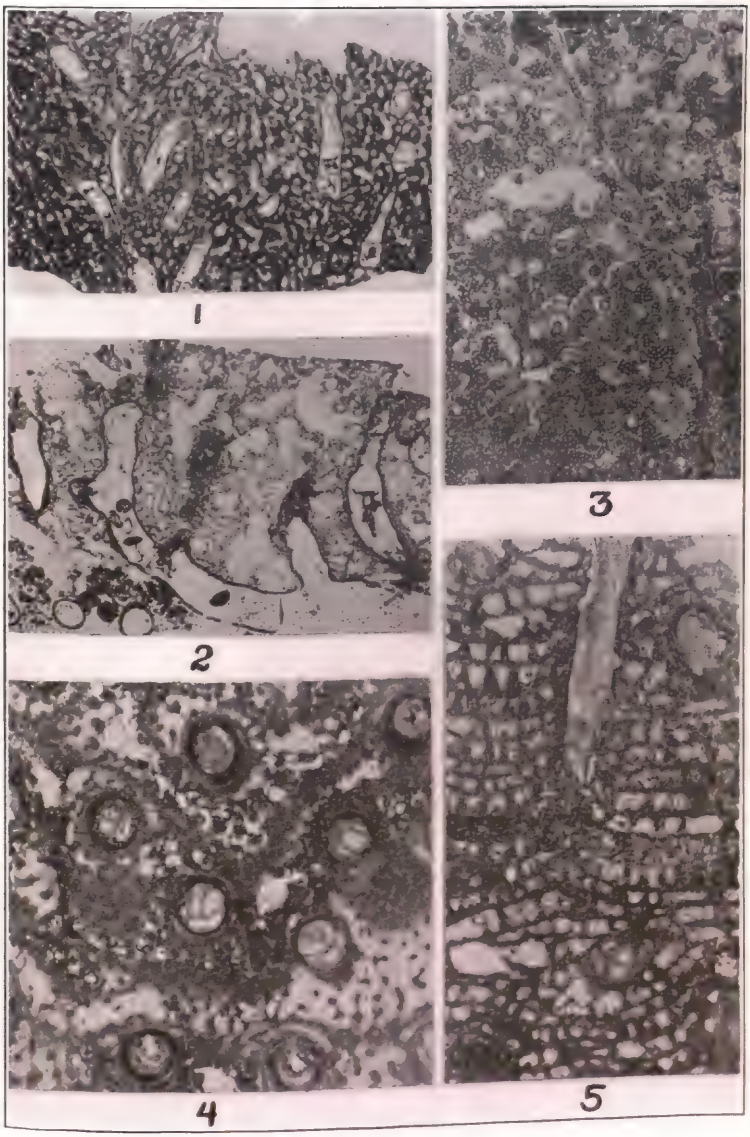

Plate XVIII

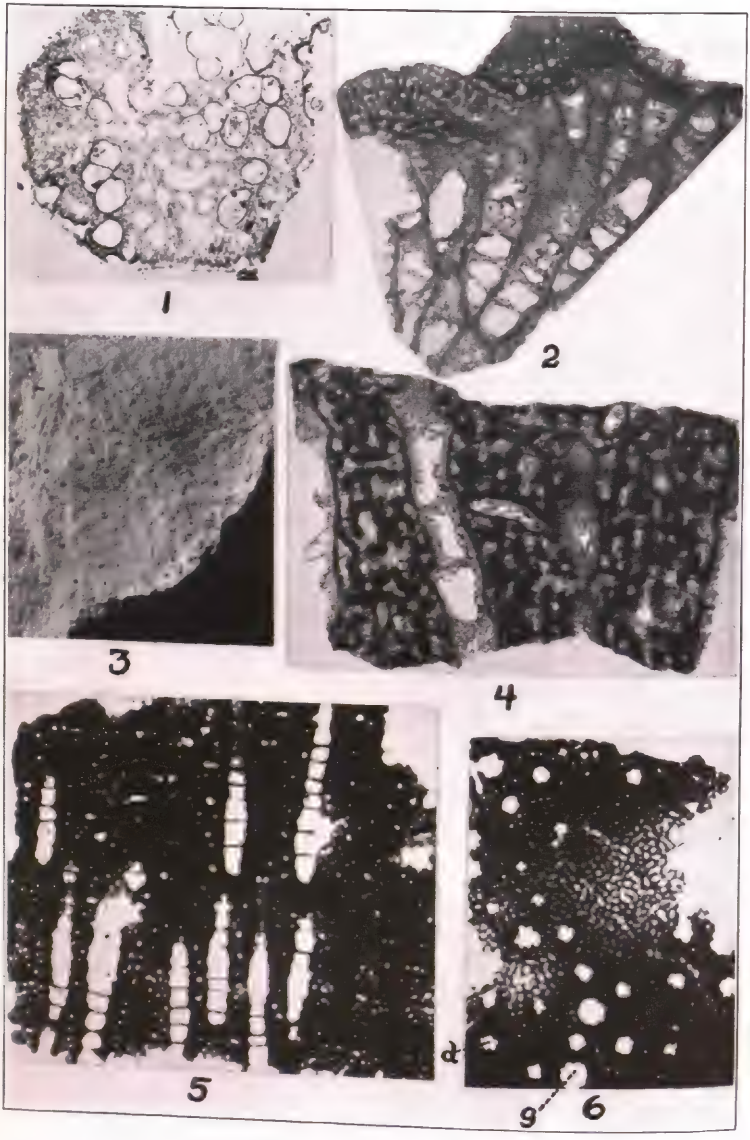

Plate XIX

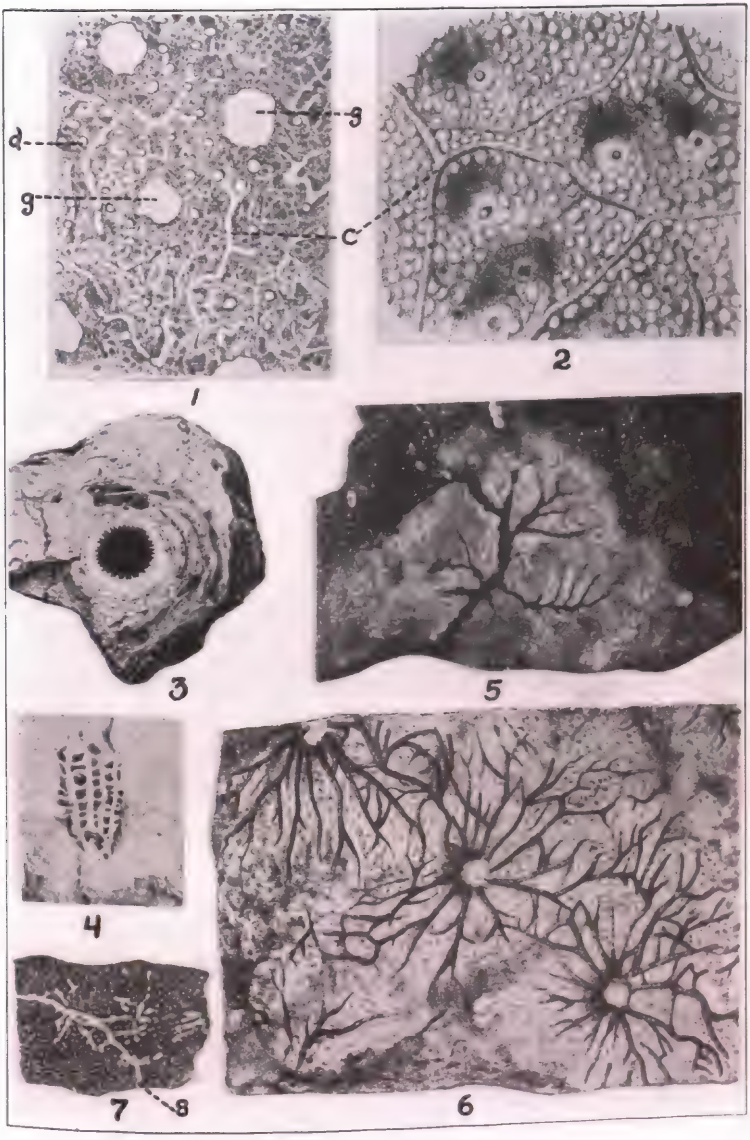

Plate XX

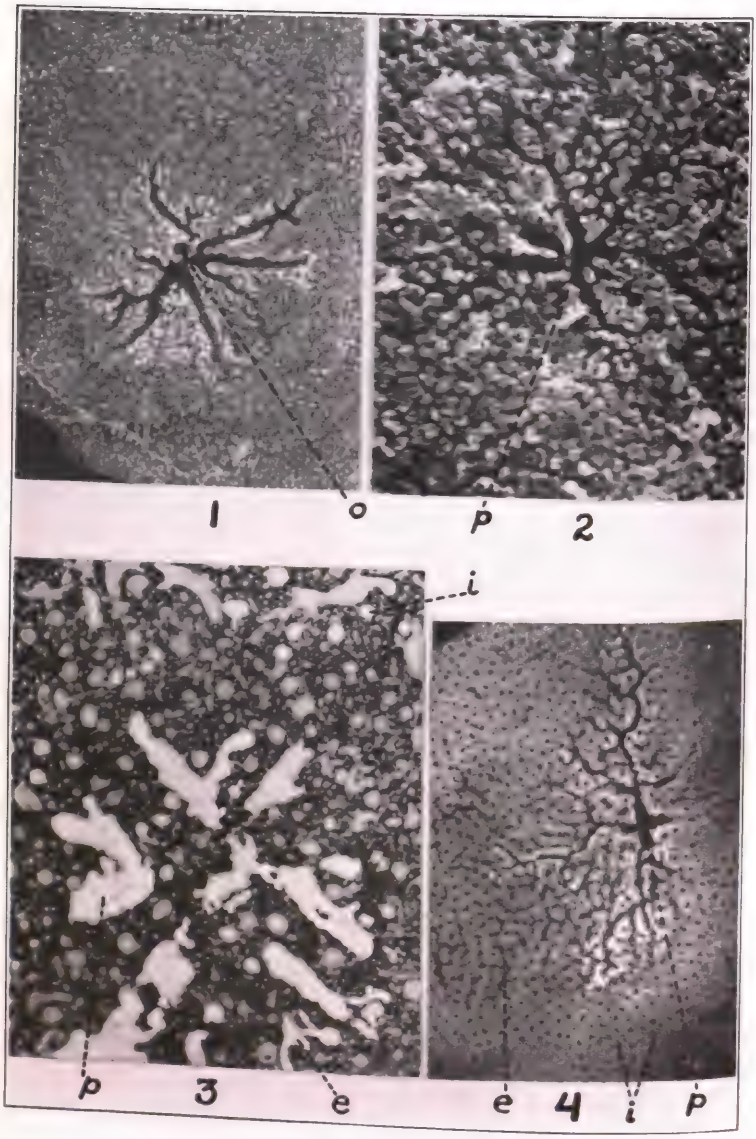

Plate XXI

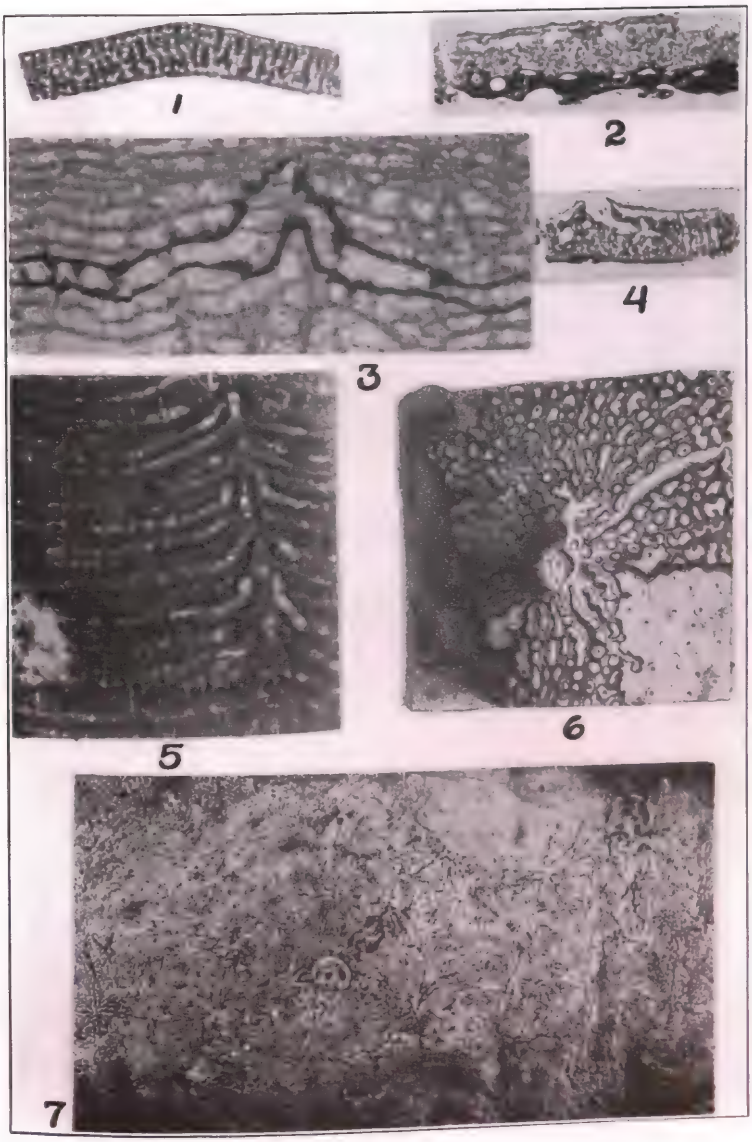

Plate XXII

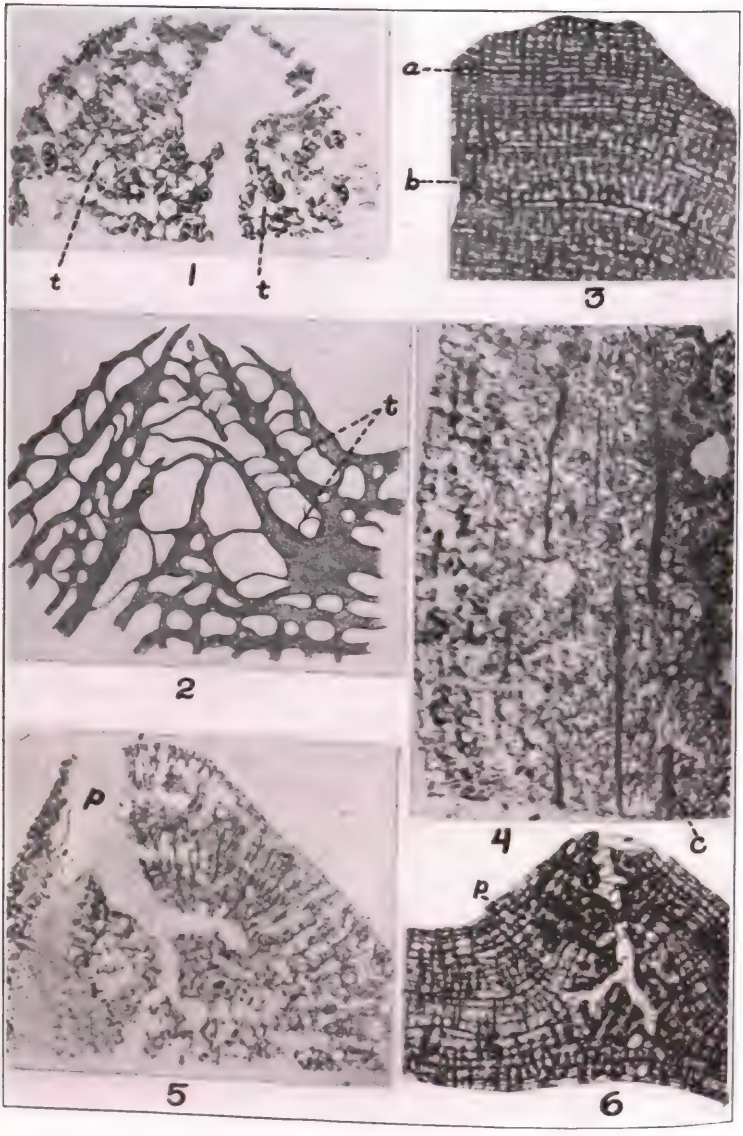

Plate XXIII

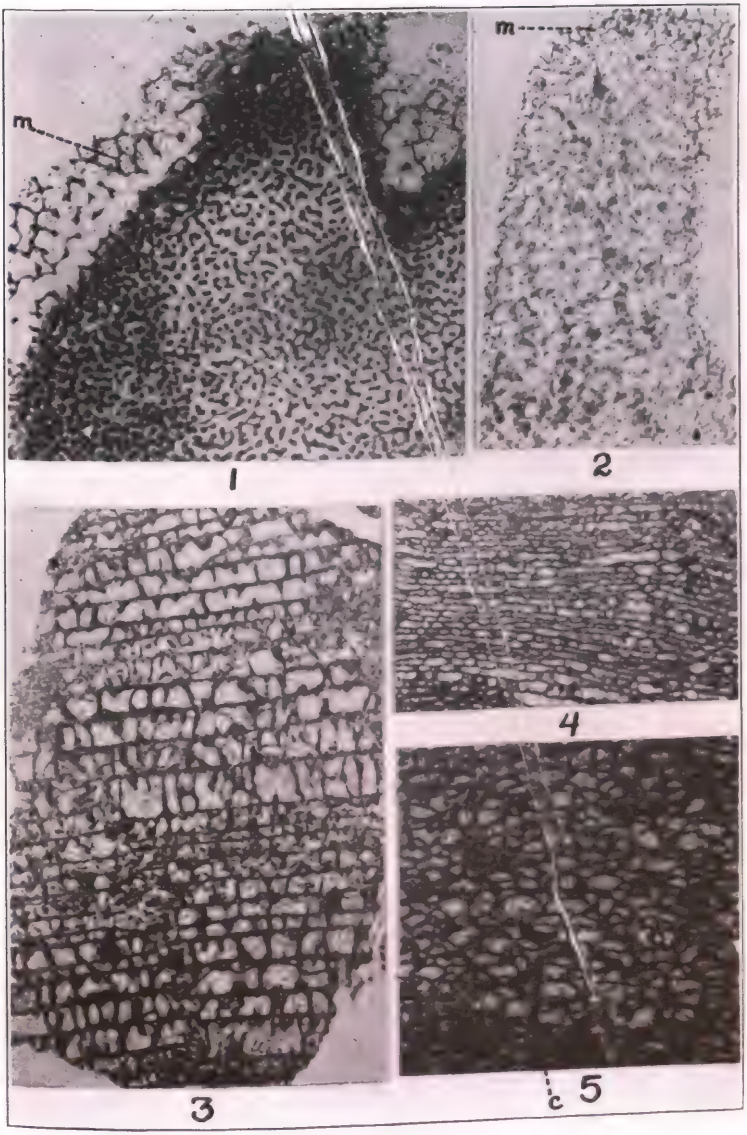

Plate XXIV

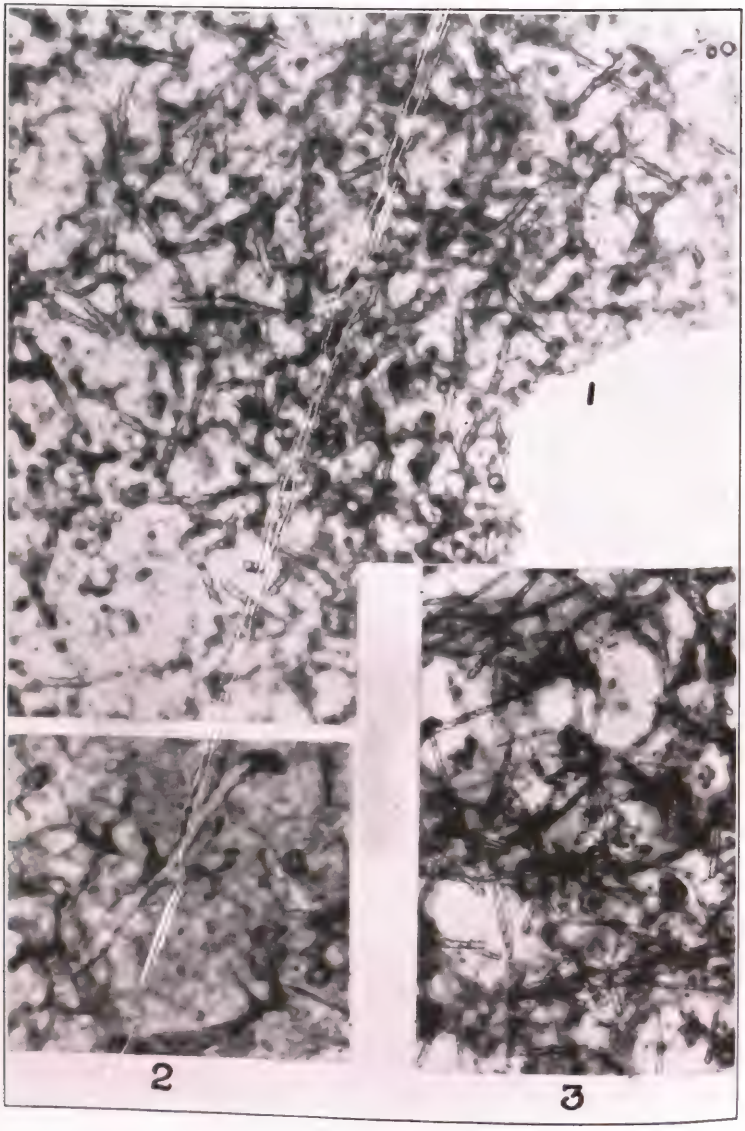

Plate XXV

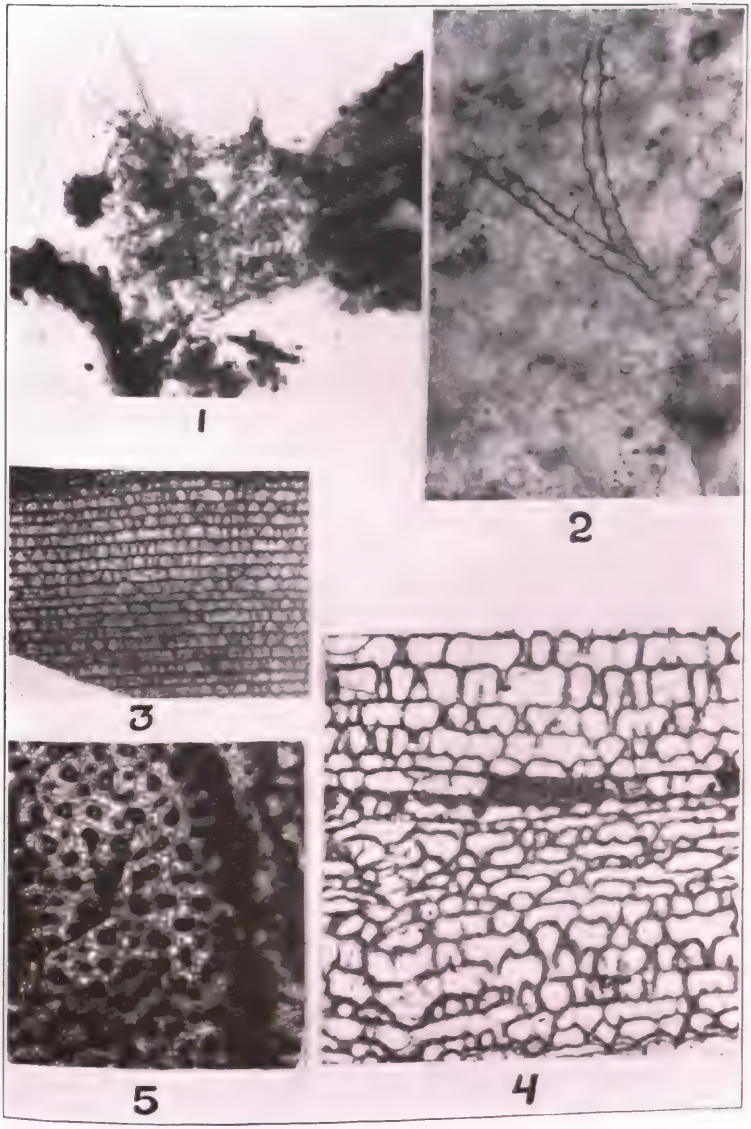

Plate XXVI

cylinder. Here they may be arranged longitudinally, or cross at any angle.

X.—PILLARS AND LAMINAE

Stromatoporoids have been described in terms of pillars and laminae; while usage has made these terms almost indispensable they will not stand critical examination.

In *Clathrodictyon striatellum* and *C. cellulosum* a hollow cone inflected from the lower layer of the lamina into an interlaminar space makes a pillar, evidently, by folding. As a rule this hollow cone does not reach the next lower lamina; but when it does it forms a tube wider at the top than at the bottom—a truncated hollow cone. In some species of *Actinostroma* the pillars are hollow and of uniform diameter throughout. They probably were formed after the manner described above. The Sandhegers thought that these hollow columns housed bryozoan zoöids.

The pillars may be exactly what their name implies or they may hang like stalactites from a lamina into an interlaminar space, in either case being produced by folding. (Plate XXVI, Figs. 3 and 4.)

Nicholson in describing *Stromatopora* says that the laminae are poorly developed and that the growth is by latilaminae, (see Plate XXII, Fig. 1), really thick lamellae. The pillars of *Stromatopora* have a very irregular arrangement often not extending completely through the lamella, and often sending off branches that may join neighboring pillars; these off-shoots Nicholson considered poorly developed laminae. The whole arrangement suggests complicated folding.

The branches of pillars that bend over and become horizontal bars in *Stromatopora* become the essential elements in *Stromatoporella*. Pillars are still in evidence but the horizontal bars have become so prominent that they suggest the laminae of other genera; these bars, however, are discontinuous, frequently bending down to form pillars extending to the next lower bar. They are part of the general folding and not limits of periodic growth.

Stromatopora and especially *Stromatoporella* suggest, by

their structure, that some laminae might also have been produced by folding for it would be but a step from the pseudo-laminae of *Stromatoporella* to the true laminae of other genera.

In *Stromatoporella* there is apparently no periodicity of growth; the units are all spread out in one plane very commonly encrusting some other organism. This encrustation may be very thin—as thin as the film formed by some of the more delicate fresh water sponges.

Stromatoporella very closely resembles in structure certain non-laminate fresh water sponges, that is, sponges that have no habit of periodic growth, (Plate XXII, Fig. 7).

The complicated arrangement of pillars and laminae in *Clathrodictyon vesiculosum*, where the laminae are so crumpled that they can hardly be distinguished from pillars and where laminae in themselves are never limits of periodic growth, suggests very strongly that pillars and many laminae may have had the same origin. Distinct laminae, and especially double laminae, may be the remains of dermal layers.

We must not look to folding to account for all of the architecture of a stromatoporoid. Off-shoots from laminae and pillars occur in some stromatoporoids; the spokes in the hub and spoke arrangement of the laminae of *Actinostroma* are probably off-shoots from the pillars and in no way due to folding. True and double laminae limiting periods of growth also occur in this genus.

Stromatoporoids are usually described as having a reticulated structure, in reference to the arrangement of pillars and laminae. This is most distinct in *Actinostroma*. *Millepora* sections do give a reticulated appearance but here the picture is produced not by cut pillars and laminae but by the cut walls of the coenosarcal tubes.

This term, reticulated, has also been used in describing the ultimate structure of pillars and laminae. It takes a strong imagination to find any reticulation here.

The texture of a stromatoporoid consists of minute indefinitely shaped granules, that may be arranged in lines, and at times two series of lines crossing at right angles. It is

usually only in the vertical lines that the granules are arranged to form anything like fibres.

In *Stromatopora* and *Stromatoporella* the pillars are porous and often pierced by what seem to be small tubes. Heinrich uses this as a basis for his classification. It seems to be assuming too much to say that the small tubes communicated with ciliated chambers but according to the hypothesis here present this would be the location of the ciliated chambers. It may be simply that the structure is coarser and more distinct in these genera than in the more delicate forms, or in a more complete form of preservation.

The granular structure gives to the sections a hazy appearance—pillars and laminae shading off without a sharp boundary such as we see at the edge of a cut wall or septum of a coral or indeed of the coenosarcal tubes of *Millepora*. Mineralization may destroy the hazy granular appearance but occasionally a crystal of calcite will be seen still including the granular remains of the original organic material of the stromatoporoid.

It seems to me that this rather strengthens von Rosen's idea that the stromatoporoids were horny sponges that had become calcified.[3] It will be seen, however, that they were probably siliceous sponges.

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[3] Friedrich Baron Rosen, über die Natur der Stromatoporen und über die Erhaltung der Hornfaser der Spongien im fossilen Zustande. Verhandlungen der Russich-Kaiserlichen Mineralogischen Gesellschaft. 2nd ser., vol. 4, pp. 1 - 98, 1869.

Nicholson speaks in the highest terms of von Rosen's work but does not accept his conclusions. Since the publication of Nicholson's monograph little attention has been paid to the really remarkable studies of von Rosen. Text books have mentioned that he considered the stromatoporoids sponges but we read nothing of the careful investigations of the conditions of fossilization, the well prepared sections and the comparisons he made between stromatoporoids and other fossil sponges.

Von Rosen speaks of errors of interpretation that had been made in the past due to scant knowledge ("mangelhaften Kenntniss") of living sponges but notes that progress was being made in this branch of zoology. Haeckel's "Die Kalkschwämme" appeared in 1872. This study was just what was needed to round out von Rosen's work, but unfortunately it appeared three years too late for his use.

XI.—CONTRACTION

Most sponges are remarkably contractile. Under changes of environment the pores or even the paragastic cavity may become entirely obliterated. The changes produced by contraction are so great among living sponges that in the past different generic names have been given to contracted and uncontracted states of the same species. A contracted *Sycon* looks like a larval sponge. Sollas, (Challenger Report), gives special names to special forms of contraction. During contraction spicules and organic matter are rolled up into what we may call adventitious columns, (Plate XXIII, Fig. 4). It would be indeed strange if fossil sponges should always be found in the expanded state. One would naturally expect to find a large proportion contracted.

Parks, (Silurian Stromatoporoids, Univ. Toronto Study Ser., No. 6, p. 6, 1909), has shown the great similarity, if not identity, of the fibres of *Actinostroma tenuissimum* and *Stromatopora typica*. He also describes a specimen of *S. constellata* "with a fine grained stromatoporoid having the typical structure of an *Actinostroma*" growing beneath it.

This is not a very unusual condition and since the intimate association of the various elements suggests that we are dealing with but one specific growth, it can, I believe be best explained on the assumption that the *Stromatopora* portion is an

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Von Rosen's conclusions can be best summed up in his own words.

"My researches have taught me that the stromatoporoids are true horny sponges differing, however, from all other sponges of the present and past by an unlimited sequence of thin lamellae, each of which actually represents an individual sponge; the stromatoporoids are, therefore in the full sense of the word, compound, (zusammengesetzte) sponges."

It appears from this that von Rosen did not know that sponges with a lamellar habit of growth occurred in the fresh waters.

Von Rosen considered each lamella, rather than each astrorhizal system, a unit of a compound sponge. Limiting units to astrorhizal systems is more in accord with modern ideas of sponge anatomy.

The discovery of remains of spicules removes the stromatoporoids from the order of horny sponges (*Ceratospongiae*) but not from the class *Demospongia*.

expanded, and the *Actinostroma* portion a contracted, state of the same organism.

A stronger suggestion of contraction than in the combination of two genera just mentioned is found in many stromatoporoids that present large pillars, or better, columns that cannot be explained as directly the result of the folding of the choanosome of a simple rhagon. These columns may extend without breaks entirely through the colony. They are massive or fibrous, never porous nor do they have the minute canals at times seen in true pillars. Pillars and columns may occur side by side or one portion of a colony may be supplied with columns while another has only pillars. All of this gives the impression that the columns are adventitious structures and that they occur only under certain conditions, in short that they are analogous to the contraction columns found in sponges. Isolated columns occur in *Stromatopora* and *Actinostroma*. In *A. bifarium* they make up an essential element of the species; in *Clathrodictyon* the columns, when they occur, are usually indistinct; the genus *Actinodityon* Parks, (Silurian Stromatoporoids, Univ. Toronto Studies No. 6, p. 30, 1909), may be a *Clathrodictyon* with such columns, according to Parks "they pass through the tissue of what is otherwise an ordinary *Clathrodictyon.*"

Nicholson rather hesitatingly founded the genus *Syringostroma* on the constant presence of the large "pillars" and gave it the name *Syringostroma* because of the astrorhizal canals shown cut across in vertical sections. They are arranged in parallel rows like the stops of a shepherd's pipe, hence the name. In Nicholson's illustration, (Geol. Surv. Ohio, vol. 2, Pt. 2, Pl. 24, Figs. 2-2b, 1875), this is well shown.

There has been great uncertainty among authors as to what should be included in the genus *Syringostroma*. Parks and even Nicholson apparently consider the two genera *Syringostroma* and *Actinostroma* closely related. *Syringostroma* columns occur in *Actinostroma* and in some species all the pillars except for size, are identical in structure with *Syringostroma* columns.

Syringostroma has been considered a subgenus of *Stroma-*

topora. In the latter genus a latilamina is actually a lamella, often of considerable tickness; but in a section including a number of lamellae some will be found thin, without broken *Stromatopora* pillars, and with the *Syringostroma*-like arrangement of cut astrorhizal tubes associated with columns, (Plate XXIII, Fig. 3). If the whole mass is made up of these layers we call it *Syringostroma;* if not, *Stromatopora.* I am inclined to think that *Syringostroma* is a contracted condition of *Stromatopora* or some other genus; that *Syringostroma* is a paleontological rather than a biological genus.

Extreme forms of contraction are occasionally to be found in stromatoporoids, contractions obliterating canals and paragastric cavities like the contraction that occurs in *Sycon;* but while the canals are gone the micro-structure still persists and one is forced to believe that our fossil is a stromatoporoid.

XII.—STROMATOPOROIDS AS LIMESTONE BUILDERS

Stromatoporoids have long been considered limestone builders of an importance equal to that of the true corals; and naturally it was assumed that, like the corals, they secreted a calcareous skeleton in life. Organisms form their skeleton and shells from the salts in solution in the waters in which they live, but dead organism may also be limestone builders to no mean extent.

Twenhofel, (Treatise on Sedimentation, p. 242, 1926), in discussing the precipitation of calcium carbonate by decaying matter says: "most limestones are composed of fossils only in part and that usually the minor part. The remaining portion consists of finely divided calcite in which are few traces of organic matter. It appears probable that this finely divided calcium carbonate was at least partly produced by precipitation through inorganic agencies or through reaction with ammonium carbonate resulting from organic activity or the decay of organic matter." Possibly a horny sponge in decaying might help in its own calcification by developing ammonium carbonate.

It is possible that stromatoporoids need not to have been lime secreting organisms for all that they even help build up

reefs. In the Upper Jura of Swabia, according to Grabau, (Principles of Statigraphy, p. 442), occur reefs "built largely of lime-secreting sponges." Grahau states that "the genus *Cnemidiastrum* predominates," *but Cnemidiastrum belongs to the Silicispongiae.* Here we have large limestone reefs built by organisms that did not secrete lime.

XIII.—SPICULES

The spicules of undoubted Silurian and Ordivician siliceous sponges are frequently calcareous, (crystalline calcite), and it is not uncommon to find siliceous sponges with no more suggestion of the presence of spicules than we find in most stromataoporoids. "The evidence indicates that many of the spicules go into solution not long after the death of their builders," (Twenhofel, Treatise on Sedimentation, p. 373).

In the Pliocene of Florida, (West Palm Beach drainage canal), modern sponges occur, fairly well preserved, with no traces of spicules, or with spicules in which the silica has been replaced by calcium carbonate.

Spicules are not necessary in relating an organism to the *Porifera.* Organisms other than sponges, i. e., the coelenterate, *Alcyonium,* contain spicules. In this discussion, in seeking an analogy stress has been laid on the anatomy of the fossil. A biologist working with living material would consider the anatomy of as great, if not of greater importance than the presence or absence of spicules; but a paleontologist who has to work with much poorer material feels the need of the distinctive spicules to correlate a fossil with the sponges, and frequently he wants big ones.

Spicules are often quite small. The dermal spicules of *Ephydatia everetti,* (a fresh water sponge), are 0.00063 inches long. It is not an easy task to find such minute structures in sections of fossils often poorly preserved. And it must be remembered that no other fossils have received so little study and that many sections would have to be made to find traces of even larger spicules that could easily be lost or altered in solution.

Spicules in modern sponges are frequently arranged in a

very characteristic meshwork, (Pl. XXIV, Fig. 2), such a meshwork, for all that individual spicules can hardly be recognized, is also to be seen in such Trenton sponges as *Zittelella lobata*, (Geol. Surv. Ill., vol. VIII, Pl. 4).

The skeleton of a stromatoporoid is a meshwork but it is usually a meshwork of comparatively heavy and indistinct elements not suggesting spicules. This is not always the case; isolated spots are occasionally found in sections where the typical stromatoporoid structure is replaced by a meshwork as distinctly sponge-like as that in the Trenton sponges just mentioned, (Pl. XXIV, Fig. 1).

In many sponges spicules are scattered, especially at the surface, in what seems a haphazard manner. This is the case in *Trochospongilla horrida*, (Pl. XXV, Fig. 3).

It has been my fortune to find in sections of *Stromatopora centrotum* (Girty) great numbers of calcareous tubes arranged in this haphazard way. All are more or less broken so it is impossible to determine the size accurately, but they are probably a trifle smaller than the broken spicules in a section of *Trochospongilla horrida* prepared for comparison.

(Spicules of fresh water sponges are often hollow and in section give the appearance of tubes. Spicules *isolated* from a sponge are apt to be flawless and so do not present the proper conditions for comparison with the broken spicules of a section. Spicules of Trochospongilla horrida are .005 inches long.)

The tubes are studded with spines similar to the spines on the spicules of *T. horrida*. Many of the spines are broken, leaving a boss or simply an irregularity in the course of the tube. They may have been as closely set as the spines on a *T. horrida* spicule (Plate XXV, Figs. 1-2; Plate XXVI, Fig. 2).

The peculiar bodies that I am inclined to look upon as spicules, though rarely found in numbers as in the specimen of *S. centrotum* just considered, do occur in many other stromatoporoids; they are usually isolated and far between as might be expected. "The evidence indicates that many of the spicules go into solution not long after the death of their builders."

XIV.—CONCLUSION

Accepting the "true stromatoporoids" as sponges complicates rather than simplifies stromatoporoid study. Spicules in the classification of sponges are often as important as teeth are in that of mammals.

Since it seems unlikely that spicules good enough for classification will be found, the architecture of the fossil must supply the basis for description. Heretofore, descriptions and measurements of laminae and pillars, with incidental mention of astrorhizae has been considered enough, though how it could suffice, even for *Hydrocorallines*, is hard to understand.

Fossils in other branches of paleontology are being described from a biological standpoint, while the stromatoporoids receive the description of curios made scientific by technical terms . It was this lack of any biological basis for the accepted descriptions of stromatoporoids that led me to seek for some logical explanation of the conditions found in them.

The accepted hypothesis seemed to offer no help so I sought elsewhere. By a strange freak of fancy my mind went back to earlier studies of the fresh water sponges to find the "faint analogy" which would serve in the study of stromatoporoids. This analogy consisted of the fact that both stromatoporoids and fresh water sponges often present similar and distinct suggestions of a primitive sponge type, the rhagon.

Since Haeckel, we have been accustomed to look upon the Calcareous sponges as the beginning from which the Porifera developed; but a simple rhagon is really as primitive in structure as is an Ascon.

It is very suggestive, and may mean much to the student of evolution, to find in the structure of the Silurian stromatoporoids a close approach to a theoretical ideal of the primitive sponge, and then to find the same in what Darwin called "the wonderful living fossils of the fresh waters."

The fresh waters are especially adapted to preserve with little change many early forms of life; the idea that bryozoans, sponges and many other forms of fresh water life are recent accessions, is without foundation. Tribolites still survive in

the fresh water *Apus; Estheria,* now a fresh water crustacean, goes back to the Cambrian.

The faint analogy, born of the fresh water sponges, received strength as my studies included marine forms. All of the sponges studied, that exhibited analogies often very striking, belonged to the *Demospongiae.* These analogies have led to the conclusion that the true stromatoporoids were the ancestors of the *Demospongiae.*

XV.—SUMMARY

The "tabulated tubes" of Nicholson have no existence; consequently stromatoporoids cannot be divided into milleporoid and hydractinoid groups.

All true stromatoporoids are built on one general plan.

Stromatoporoids, like sponges, consist of a number of biological units intimately connected with each other. The simplest form, (*Stromatoporella*), consists of one layer of units. In most stromatoporoids periodic growth, like that in the sponge *Trochospongilla leidyi,* builds up many layers or lamellae; but the intimate connection between units still persists.

A unit is made up of an astrorhizal system. The astrorhizae are homologous with the astrorhizae of sponges.

The center of an astrorhizal system, as in the fresh water sponge *Spongilla fragilis,* is in structure a close approach to the ideal of a simple rhagon. Deviations from the simple rhagon type occur in some stromatoporoids; these deviations are like those that occur in sponges.

Contractions occurred in stromatoporoids changing the structure, as do the contractions that occur in sponges.

Spicules, though rare, exist.

The true stromatoporoids were the ancestors of the modern *Demospongiae, and themselves were sponges.*

PLATE XVIII

FIGURE PAGE

1. Caunopore tubes in *Stromatopora*---------- 276
   Branching tube at left probably an alga; section does not show the stem from which the branches arise. Simple tubes at right are probably zoophytes. x 5.
2. Caunopore tubes in *Carterius*, (a fresh water sponge). The tubes are *Plumatella princeps*, (a fresh water bryozoan). Vertical section. x 10.
3. Surface of an undescribed species of *Clathrodictyon* with typical caunopore tubes. x 2.
4. Horizontal section of same. x 10.
5. Vertical section of same. x 10.

PLATE XIX

1. Horizontal section of *Carterius*, (a fresh water sponge), with caunopore tubes of *Plumatella princeps*, (a fresh water bryozoan.) x 10.
2. Stromatoporoid growing on *Favosites*. x 5.
3. Surface of *Stromatopora* with openings of caunopore tubes made up of a variety of organisms. x 1.
4. Caunopore tube of a tabulated coral resembling a zooidal tube of *Millepora*. x 10.
5. Vertical section of *Millepora*. Tabulated zooidal tubes resemble the caunopore tube in Fig. 4. x 10.
6. Horizontal section of Millepora D, dactylopores G, gastropores. x 10.

PLATE XX

1. Horizontal section of *Millepora* (after Nicholson). d, Dactylopores g, Gastropores c, Coenosarcal tubes, Nicholson's analogues of astrorhizae. x 24.
2. Surface of *Hydractinia circumvestieus* (after Nicholson). c, Coenasarcal tubes, Nicholson's analogue of astrorhizae. x 24.
3. Coral encompassed by stromatoporoid. x 1.
4. Coral encompassed by stromatoporoid. x 1.
5. *Spongilla fragilis* ---------- 283
   Astrorhizae of fresh water sponge found late in the season. Earlier in the season astrorhizae are more delicate. Compare with Fig. 6 of this plate and Plate XXI, Fig. 1. x 1.
6. *Stromatoporella eifeliensis*, (after Nicholson) ---------- 282
   Surface showing astrorhizae. x 1.

FIGURE PAGE

7. A Niagaran stromatoporoid belonging to an undescribed genus ____ 283
S, Stolon leaving astrorhizal center to connect with astrorhizae at a lower level. x 2.

PLATE XXI

1. *Stromatopora monticulifera* ____ 283
Surface showing true astrorhizae surrounded by negative astrorhizae. o, osculum separated from astrorhizae by tabeculae. x 10.
2. *Stromatopora monticulifera* ____ 284
Fracture removing upper lamina or rhagon. The rhagon is differentiated into cavity and astrorhizal tubes. P, Paragastric cavity. x 10.
3. *Spongilla fragilis* ____ 283
Horizontal section showing P, astrorhizal tubes of paragastric cavity; e, excurrent tubes (continuations of astrorhizae); i, incurrent tubes. x 10.
4. *Stromatopora foveolatum* (Girty) ____ 284
Horizontal section P, Paragastric cavity; e, excurrent tubes; i, incurrent tubes. Compare with Fig. 3. x 10.

PLATE XXII

1. *Stromatopora densum* ____ 293
A lamella showing irregular broken pillars. Compare with pillars of *Spongilla fragilis* Fig. 4. x 4.
2. *Trochospongilla horrida* ____ 291
This shows a double dermal layer. x 5.
3. *Clathrodictyon,* (an undescribed species from the Niagaran) ____ 285
Vertical section showing a Rhagon. x 20.
4. *Spongilla fragilis* ____ 285
Compare differentiated rhagon with rhagon of Fig. 3. Vertical section. x 5.
5. *Stromatopora foveolatum* (Girty) ____ 283
Astrorhizal cylinder made up of superimposed units, (rhagons). Vertical section. x 10.
6. *Stromatoporella granulata* after Nicholson ____ 282
Perforated dermal layer shown at lower right hand corner, compare with vertical section of dermal layer of sponge shown in Fig 4. x 6.
7. *Stromatoporella,* an undescribed species from the Devonian of Northern Michigan ____ 294
An encrusting stromatoporoid of the thickness of a delicate encrusting fresh water sponge. x 2.

PLATE XXIII

FIGURE — PAGE

1. *Apysina flagelliformis,* (a Marine Sponge) ---- 292
   t, trabeculae in excurrent tubes. Vertical section. x 5.
2. *Stromatoporella eifeliensis.* Diagramatic section after Nicholson ---- 292
   Compare trabeculae, t, with those shown in Fig. 1.
3. *Stromatopora densum* (Nicholson) ---- 298
   Two genera as now defined are in this one specimen: a, *Syringostroma* and b, *Stromatopora.* x 4.
4. *Chalina arbuscula,* (Marine Sponge) ---- 296
   C, Contraction columns. Vertical section. x 10.
5. *Chalina arbuscula* ---- 289
   Vertical section showing the Paragastric cavity, P. x 10.
6. *Actinostroma,* (an undescribed species) ---- 289
   Vertical section showing the paragastric cavity, P. x 10.

PLATE XXIV

1. *Clathrodictyon* (an undescribed species) ---- 300
   Tangential section showing a spicular mesh, M. x 10.
2. *Chalina arbuscula* ---- 300
   Tangential section showing a spicular mesh, M. Compare with Fig. 1. x 10.
3. *Clathrodictyon* (an undescribed species) ---- 289
   Vertical section showing laminae. x 10.
4. *Clathrodictyon variolare* ---- 289
   Vertical section showing laminae. The long open spaces are due to astrorhizal tubes being cut longitudinally. x 10.
5. *Syringostroma cf. baretti* Girty ---- 296
   This is probably a *Clathrodictyon* with contraction columns similar to *Actinodictyon.* Vertical section. x 10.

PLATE XXV

1—2. *Stromatopora centrotum* (Girty) ---- 300
   1. Horizontal section showing numerous spicules. x 150.
   2. The same showing one spicule with just one, (unretouched), spine in focus. x 360.
3. *Trochospongilla horrida* ---- 300
   Horizontal section showing the spicules of a fresh water sponge. Compare the spicules of this figure with those shown in Fig. 1. The spicules measure .005 inches in length. x 82.

PLATE XXVI

FIGURE — PAGE

1. Young fresh-water sponge, *Carterius* ---------- 280
   This individual started growth between two tubes of *Plumatella princeps* and would have finally enveloped the entire colony of fresh-water bryozoans, if it had been left undisturbed. The bryozoan tubes would have become caunopore tubes in the sponge mass. x 82.
2. *Stromatopora centrotum* (Girty) ---------- 300
   Two spicules with several spines in focus. x 360.
3. *Clathrodictyon striatellum* (D'Orb.) ---------- 288
   A vertical section showing the pillars in the shape of hollow cones. x 10.

4—5. *Clathrodictyon cellulosum* (Nicholson) ---------- 288

4. Vertical section showing the folding of the pillars. x 10.
5. Tangential section showing the hollow cones, (negative astrorhizae). x 10.

A LIST OF PLANTS GROWING UNDER CULTIVATION IN THE VICINITY OF COLD SPRING HARBOR, NEW YORK.

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I. INTRODUCTORY.

There are probably more species of introduced and cultivated plants on Long Island in proportion to its area than in most other parts of the country. One reason is that the district has been planted a longer time. Additional factors are the large amount of importing which has taken place in the past, and the extensive works in landscape architecture which have been executed there. The imported plants appear to have been brought principally from England, France, Holland, and Japan.

Long Island has been found particularly valuable in recording the effects of the climate and soil of other regions by affording an opportunity to observe the gradual failure of introduced species of trees and plants. [1] Thus a list of some of the plants in cultivation on Long Island at this time may be valuable in future years if only for the fact that it may indicate

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† The compilers are indebted to Professor O. E. Jennings of the Department of Botany, University of Pittsburgh, for criticism of the manuscript, and to the Library of Dartmouth College for many courtesies facilitating their work.

[1] A brief discussion by the senior author of the physical conditions affecting plant life on Long Island together with the more common cryptogams and phanerogams recorded as native from the region is found in the American Midland Naturalist Vol. IX, nos. 6, 7, 9, 10, 11, 1924-25, pp. 1-252. These lists also include a few species introduced on Long Island, but the great majority of those thus considered are native to the northeastern portion of North America.

those species which have survived or become naturalized, or in the words of the late Professor Sargent, "valuable for what is not there."

The plants whose presence we record should be regarded only as embodying a minority percentage of the species of plants which are under cultivation on Long Island at this time (1926), and of course can not include the many introduced species which are planted every year on the various estates. A very few of the plants we list are not found growing in the open but only in green houses, but the rest of the data should prove advantageous to some plant systematists as well as to students of landscape architecture, (*) who are interested for one reason or another in the various families of seed plants growing on Long Island at the present time. It also indicates the attractive opportunities which exist for the study of Hemerecology on Long Island, [2] while plant morphologists, physiologists, pathologists and cytologists will find conveniently at hand much material of a type not ordinarily obtainable in the vicin-

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* An elaborate system of public parks has been projected and partly executed on Long Island. For details see the Reports of the State Council of Parks, obtainable at 302 Broadway, New York. With such developments, the study of the cultivated plants of Long Island assumes increased importance.

[2] Harshberger, J. W. The Ecology of Cultivated Fields, Parks and Gardens. Ecology IV: 297-306. It is understood that Dr. Harshberger is making a study of the old cellar holes of Long Island, with especial regard to the cutivated plants persisting about them.

It seems of value to cite at this place three works containing references to the flora and old gardens of Long Island.

1818-19. Cobbett, William. A Year's Residence in the United States of America. Published in New York and London. Printed for the author by Clayton and Kingsland.

1833. Stuart, James. Three years in North America. See Vol. I for references to old gardens. Edinburgh. Cadell.

1909. Jameson, J. Franklin. Narratives of New Netherlands, 1609-69. Among "original" narratives of Early American History series. Scribners, 1909. On p. 298 are given lists of native plants, 1650. Medical plants to the number of 30-40 are enumerated, presumably intended to cover Long Island as much as any part of the province.

ity of a summer biological laboratory. The estates on which these plants were growing are well within a thirty mile radius of the Biological Laboratory, Cold Spring Harbor, New York. The following summary of our data [1] indicates in part the present richness in plant families of this particular region of Long Island.

	No. Living Families (Engler and Prantl)	No. Families represented in list of Cultivated Plants	No. Families represented in list of Native Plants	Total Number Families on Long Island	No. Genera Cultivated Plants in List	No. of Species Cultivated Plants in List
Pteridophyta	17	6	9	9	26	43
Gymnospermae	5	4	2	4	39	214
Monocotyledoneae	45	16	19	25	129	220
Dicotyledonae	243	110	96	123	513	1607
Totals	310	136	126	161	707	2084

It may be of interest to observe at this point that the following families listed as being present in the native flora of the region (1) are missing from this list of cultivated plants.

PTERIDOPHYTA: *Ophioglossaceae, Marsiliaceae. Equisetaceae, Isoetaceae. MONOCOTYLEDONEAE*: *Sparganiaceae, Zannichelliaceae, Zosteraceae, Scheuchzeriaceae, Vallisneriaceae, Lemnaceae, Xyridaceae, Eriocaulaceae, Pontederiaceae, Juncaceae, Melanthaceae, Smilaceae. DICOTYLEDONAE*: *Saururaceae, Cannabinaceae, Urticaceae, Santalaceae, Phytolaccaceae, Corrigiolaceae, Aizoaceae, Alsinaceae, Ceratophyllaceae, Callitrichaceae, Monotropaceae, Cuscutaceae, Lentibulariaceae, Orobanchaceae, Phrymaceae, Plantaginaceae, Ambrosiaceae.*

Families given only in this list, and not in the native flora of the region (1) are:

PTERIDOPHYTA: *Cyatheaceae* (?)

GYMNOSPERMAE: *Cycadaceae, Ginkgoaceae.*

MONOCOTYLEDONEAE: *Pandanaceae, Aponogetonaceae* (?), *Palmaceae, Musaceae, Cannaceae, Marantaceae, Garryaceae. DICOTYLEDONAE*: *Proteaceae, Nyctaginaceae, Basellaceae, Trochodendraceae, Lardizabalaceae, Calycanthaceae, Resedaceae, Pittosporaceae, Tropaeolaceae, Meliaceae, Empetraceae, Coriariaceae, Dilleniaceae, Ternstroemiaceae, Tamaricaceae, Begoniaceae, Thymelaeaceae, Punicaceae, Myrtaceae, Diapensiaceae, Myrsinaceae, Sapotaceae, Loganiaceae, Gesneriaceae.*

II. ACKNOWLEDGEMENTS.

The basic data for this list was secured through the courtesy of the owners, superintendents, or other officials of the following estates:

1. Estate of Mr. Frank Bailey, Locust Valley—Mr. Frank Bailey. [3]
2. Country Life Press, Garden City—Mr. Leonard Barron, Editor. [4]
3. Home of C. B. Davenport, Cold Spring Harbor—Dr. and Mrs. C. B. Davenport.
4. Estate of Mr. Henry DeForest, Cold Spring Harbor—Mr. J. G. Melrose.
5. Estate of Mr. Childs Frick, Clayton—Mr. Childs Frick. [5]
6. Estate of T. A. Havemeyer, Locust Valley—Mr. Albert LaHodney.
7. Hicks Nurseries, Westbury—Mr. Henry Hicks. [6]
8. Estate of A. G. Hodenpyl, Locust Valley—Mr. Edward Wood. [7]

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[3] The Bailey estate is well known for its collection of Delphiniums.

[4] The Evergreen Garden, (Country Life Press, Garden City, N. Y., 1920) P. 1-8. The pamphlet contains an incomplete list of the plants under cultivation at the Country Life Press. Typewritten lists furnished the compilers by Mr. Barron were additional sources of records from this locality.

[5] Childs Frick, "Pinetum Claytonense—A List of the Varieties of Coniferous Plants Growing at Clayton, N. Y." Privately printed, 1924. Pp. 1-27. This collection was started in the spring of 1919 and now comprises some twenty-six genera and some one hundred and ninety species. Few specimens have reached the height of twenty feet. Many of the rare varieties are represented only by seedlings.

[6] The Hicks Nurseries feature acid soil plants.

[7] The compilers desire to express their appreciation of courtesies extended by Mr. Hodenpyl in connection with the preparation of this list. Of interest to students of the cultivated plants of Long Island is

9. Estate of Mr. Otto Kahn, Cold Spring Harbor—Mr. John A. Forbes.

10. Estate of W. J. Matheson, Lloyd Neck, Huntington—Mr. James Kirby.

11. Estate of Mr. G. D. Pratt and "Dana Island," Glen Cove—Mr. J. T. Johnson. [8]

12. Estate of Mr. Louis C. Tiffany, Laurelton—Mr. Stanley Lathrop.

13. Estate of J. N. Willys, Center Island—Mr. William MacKay.

Mr. Hodenpyl's card index of the plants growing upon his estate. The home of Mr. Hodenpyl is known as Hill House, and is located on the Piping Rock Road, Locust Valley, Long Island. The home is Elizabethan in architecture, brick and half timber, and the grounds cover 120 acres. About one-half is covered with beech, birch, hickory maple, dogwood and white pine woods, with much planting of suitable shrubbery and native wild flowers. A large number of paths in the open are planted with many dogwoods, wild roses and species of *Berberis, Cercis, Cotoneasters, Viburnums, Malus,* etc.

Among the special groups of plants featured on this estate are a considerable planting of evergreens in a large group—Cedars, hemlocks, white pines, Scotch and Mugho pines, varieties of *Taxus,* Arbor Vitae, Heather, *Kalmia, Rhododendron, Andromeda, Leucothöe,* etc., and numerous evergreen ground covers. There is also a collection of *Berberis,* evergreen and deciduous—perhaps 25 varieties in one planting; a collection of Cotoneasters of twenty-nine varieties, two of each kind; a collection of *Cornus* ten or twelve varieties, including *Kousa,* (Japanese and Chinese) and Korean; a collection of *Viburnums;* a lilac garden of forty varieties; numerous and quite large plantings of Azaleas—sp. *Vaseyi, calendulaceum canadense, nudifora, japonica, Kaempfferi* with a few plants of other varieties; a planting of ten or twelve varieties of *Malus,* and many varieties of trees and shrubs in smaller numbers; in moist ground around springs and a small stream and pond—plants requiring moisture. There is also a collection of hybrid American wild asters. A soil acidity map of Mr. Hodenpyl's garden was made in 1923 by E. T. Wherry. (Ecology 4:395-401.) This is indicative of the opportunities for scientific research which exist in connection with the study of the cultivated plants of Long Island.

[8] This is the west one of the two small islands situated in the sound adjoining the Pratt estate.

III. A LIST OF PLANTS GROWING UNDER CULTIVATION IN THE VICINITY OF COLD SPRING HARBOR, NEW YORK.

The plants are catalogued following the general arrangement given in the Engler and Prantl "Syllabus der Pflanzenfamilien (1919), but where possible the nomenclature used has been that given in "Standardized Plant Names." [9] As this was not always found practicable a few species have been listed following the nomenclature of the Bailey "Standard Cyclopedia of Horticulture" and "Manual of Cultivated Plants."

It is important that those who find a use for this work realize its limitations from the start. The authors have not seen every species they have listed, but have combined the records of plants they identified themselves with those obtained through the cooperation already indicated. It is believed that these additional records are unusually reliable under the circumstances. Neither do we possess supporting specimens for any of the species listed for the reason that it would have been impossible, impracticable or discourteous to obtain them.

This work, however, is submitted in good faith, not with the idea that it renders unnecessary a more elaborate and annotated list, but as a trail maker for those more deeply concerned with the Systematic Botany of the region. Those interested in the plants of this list from the standpoint of other fields of Botany will of course make sure of their identifications from such works as Bailey's "Manual of Cultivated Plants and "Cyclopedia of Horticulture" or other standard works. Undoubtedly errors will be found to occur in the

[9] Standardized Plant Names—a catalogue of approved scientific and common names of plants in American commerce. Published by the American Joint Committee of Horticultural Nomenclature, Harlan P. Kelsey, Secretary, Salem, Mass., 1923.

catalogue, and when so discovered, the reader will confer a favor by reporting them to us.

It will be noted also that a small number of the species listed from the estates are also native to Long Island. In most cases, however, they were transplanted to them, and undoubtedly receive the same care extended the introduced plants of the same type of environment where they are found growing. An additional consideration in listing them has been the convenience of the user of this list.

PHYLUM XI. EUMYCETES
CLASS III. BASIDIOMYCETES
ORDER I. HEMIBASIDIALES
AGARICACEAE

Agaricus campestris L. Common Mushroom, Pratt.

PHYLUM XIII. EMBRYOPHYTA ASIPHONOGAMA (ARCHEGONIATAE)
SUB-PHYLUM II. PTERIDOPHYTA
CLASS I. FILICALES
ORDER III. FILICALES LEPTOSPORANGIATAE
OSMUNDACEAE

Osmunda cinnamomea L. Cinnamon Fern. De Forest, Hodenpyl, Havemeyer.

Osmunda claytoniana L. Clayton's Fern. De Forest, Hodenpyl, Havemeyer.

Osmunda regalis L. Royal Fern. De Forest, Hodenpyl, Havemeyer.

CYATHEACEAE

Cibotium Schiedei Schlecht & Cham.. Mexican Cibotium, Pratt.

Dicksonia antarctica Labill. Hayemeyer.

POLYPODIACEAE

Adiantum cuneatum Langsd. & Fisch. Delta Maidenhair Fern. Tiffany. Var. *croweanum* Benedict. Crowe Maidenhair Fern. Tiffany.

Adiantum gracillimum Scheid. Mist Maidenhair Fern. Tiffany.
Adiantum pedatum L. American Maidenhair Fern. Kahn, DeForest, Hodenpyl, Bailey, Hicks.
Adiantum tenerum Sw. var. *Bausei* Hort. Bause Maidenhair Fern, Kahn. var. *Farleyense* Nichols, Havemeyer.
Alcicornium bifurcatum C. Chr. Staghorn Fern. Matheson.
Asplenium Belangeri Kunze. Havemeyer.
Asplenium platyneuron (L) Oakes. Ebony Spleenwort. Hicks.
Asplenium trichomanes (L) Maidenhair Spleenwort. De Forest, Country Life Press.
Athyrium Filix-femina Roth. Lady Fern. Woods, DeForest, Pratt.
Athyrium (*Asplenium*) *thelypteroides* Michx. Hodenpyl.
Camptosorus rhizophyllus (L.) Link. Walking Fern. De Forest.
Cystopteris bulbifera (L.) Bernh. Berry Bladder Fern. Hodenpyl.
Cystopteris fragilis (L.) Bernh. Brittle Fern. Hodenpyl.
Dennstaedtia (*Dicksonia*) *pnnctilobula* Moore. Hay Scented Fern. Hodenpyl, Country Life Press.
Cyrtomium falcatum Presl. House Hollyfern. Matheson, Tiffany.
Cyrtomium Fortunei J. S. M. Havemeyer.
Dryopteris Clintoniana D. C. Eaton. Clinton Foodfern. Hodenpyl.
Dryopteris cristata (L.) A. Gray. Hodenpyl.
Dryopteris dentata C. Chr. Downy Woodfern. Havemeyer.
Dryopteris filixmas Schott. Hodenpyl.
Dryopteris Goldiana (Hook) A. Gray. Hodenpyl.
Dryopteris hexagonoptera (Michx.) C. Chr. Winged Woodfern. Hodenpyl.
Dryopteris Linnaeana C. Chr. Oakfern. Hodenpyl.
Dryopteris marginalis (L.) A. Gray. Hodenpyl, DeForest.
Dryopteris noveboracensis (L.) A. Gray Hodenpyl, DeForest.
Dryopteris phegopteris (L.) C. Chr. Narrow Beechfern. Hodenpyl.
Dryopteris spinulosa (Muehl.) Kuntze. Hodenpyl. DeForest.
Matteucia Struthiopteris (L.) Tod. DeForest, Hodenpyl.

Nephrolepis exaltata bostoniensis Davenport. Boston Fern. Bailey.
Onoclea sensibilis (L.) Sensitive Fern. Hodenpyl.
Phyllitis Scolopendrium Newm. Harts-Tongue Fern. Pratt, Hodenpyl.
Polypodium aureum L. Golden Polypody. Tiffany.
Polypodium vulgare L. Common Polypody. Havemeyer, Tiffany, Pratt.
Polypodium Phymatodes L. East Indian Polypody. Havemeyer.
Polystichum acrostichoides (Michx.) Schott. Christmas Fern. DeForest, Hodenpyl, Hicks, Country Life Press.
Polystichum aculeatum Schott. Hodenpyl.
Polystichum braunii (Spenner) Fee. Hodenpyl.
Polystichum munitum Kaulf. Giant Hollyfern. Hodenpyl.
Pteris cretica L. Cretan Brake. Havemeyer.
Pteris multifida Poir. Spider Brake. Havemeyer.
Woodsia ilvensis (L.) R. Br. Rusty Woodsia. Country Life Press.
Woodsia obtusa (Spreng) Torr. Obtuse leaved Woodsia. Country Life Press.
Woodwardia areolata (L.) Moore. Chainfern. Hodenpyl.
Woodwardia virginica (L.) Sm. Virginia Chainfern. Hodenpyl.

SALVINIACEAE

Azolla caroliniana Willd. Tiffany.
Salvinia auriculata Aubl. Tiffany.

CLASS IV. LYCOPODIALES

ORDER II. LYCOPODIALES ELIGULATAE

LYCOPODIACEAE

Lycopodium complanatum. L. Ground Cedar. Hodenpyl.
Lycopodium obscurum L. Ground Pine. Hodenpyl.

ORDER II. LYCOPODIALES LIGULATAE

SELAGINELLACEAE

Selaginella apus Spring (*apoda* SPN) Basket Selaginella. Hodenpyl.

PHYLUM XIV. EMBRYOPHYTA SIPHONOGAMA (PHANEROGAMA)

CLASS AND SUB-DIVISION I. GYMNOSPERMAE

ORDER II. CYCADALES
CYCADACEAE

Cycas revoluta Thunb. Sago Cycas. Matheson.

ORDER IV. GINKGOALES
GINKGOACEAE

Ginko biloba L. Ginkgo. Bailey, Davenport, Willys, Matheson (male and female), DeForest, Hodenpyl, Hicks, Pratt, Havemeyer, Frick, Country Life Press; var. *Fastigiata* Hort. Frick.

ORDER V. CONIFERAE (CONIFERALES)[10]
TAXACEAE

Biota elegans Hort. Country Life Press.

Cephalotaxis drupacea Sieb. & Zucc. Japanese Plum. Bailey, Hodenpyl, Dana Island, Frick; var. *fastigiata* Pilger, Frick.

Cephalotaxus Fortunei Hook. Frick.

Podocarpus macrophylla Don. Yew Podocarpus. Dana Island. Havemeyer.

Taxus baccata L. (*Taxus brevifolia* SPN? Western Yew) English Yew. Matheson, Hicks, Bailey, Pratt, Havemeyer, Frick, Country Life Press. var. Dovestcn Yew (*Dovastoni* Laws) Bailey; Golden English Yew (*aurea* Carr.) Bailey, Frick; Golden Irish Yew (*fastigiata aurea,* Standish) Country Life Press, Frick, DeForest; Irish Yew (*fastigiata* Loud) Parsons, DeForest, Bailey, Frick; Spreading English Yew (*repandens*) Frick, Bailey, Kahn, Hodenpyl, Country Life Press. Variegated English Yew (*variegata* West) Bailey; Yellowberry Yew (*lutea* Endl.) Country Life Press, Bailey; *erecta* Loud; *Washingtoni,* Beiss, Frick and Country Life Press; *adpressa* Carr. Frick

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[10] The synonomy in this and certain other sections of the manuscript has been obtained through reference to "The Cultivated Evergreens." L. H. Bailey, The MacMillan Co., N. Y. City, N. Y., 1923.

Country Life Press; Short Leaf Yew (*aurea* SPN?), *erecta* Nicholls; *adpressa Dovastoni* SPN?, *Dovastoni variegata* Carr. *pendula* Hort, *ericoides* SPN. Frick.

Taxus canadensis Marsh. Canada Yew. Frick, Bailey, DeForest, Hodenpyl, Hicks, DeForest, Dana Island, Country Life Press, Havemeyer.

Taxus cuspidata Sieb. & Zucc. Japanese Yew. Frick, Bailey, Tiffany, Kahn, C. S. H. (Carnegie), DeForest, Hodenpyl, Hicks, Pratt, Havemeyer, Country Life Press; varieties *aurea* Hort. (*aurescens?*), *nana* Rehd., *densa* Rehd., *Hicksii* Rehd., DeForest, Bailey, Hicks, Country Life Press. "Korean" Frick. *aurescens* Rehd., Country Life Press.

Taxus "Wilsoni"? Chinese Yew. Frick.

Torreya californica Torr. California Nutmeg. Frick.

Torreya nucifera Sieb & Zucc. Hicks, Bailey, Havemeyer, Dana Island, Frick.

Torreya taxifolia Arn. Hicks.

PINACEAE

Abies amabilis Forb. Cascade Fir. Bailey.

Abies balsamea (L) Mill. Balsam Fir. Frick. Varieties: *Hudsonia* Engelm. Hudson Fir; *Hudsonia glauca* SPN, *Macrocarpa* Kent, Frick.

Abies cephalonica Loud. (*regina-ameliae* Loud.) Greek Fir. Pratt, Havemeyer, Frick. Country Life Press. Var. *apollinis* Link, Frick.

Abies cilicia Carr. Cilician Fir. Dana Island, Frick.

Abies concolor Lindl. & Gord. White Fir. Hodenpyl, Matheson, Bailey, Hicks, Pratt, Havemeyer, Frick, Country Life Press. Var. *lowiana*, A. Murr. Pacific White Fir, Hicks; Var. *argentea* Niemetz, *Wattezii* Beiss, Frick.

Abies Delavayi Franch. Delavay Fir, W. China. Frick.

Abies Fargesii Franch. Farges Fir. Frick, Country Life Press.

Abies Faxoniana Rehd. and Wils. Faxon Fir, W. China. Frick.

Abies firma Sieb. & Zucc. Momi Fir. Hicks, Frick. Var. *tschonoskiana* (SPN). Frick.

Abies Forrestii Craibb. Frick.

Abies Fraseri (Pursh) Poir. Fraser Fir or She Balsam. Frick, Bailey. Var. "*prostrata* SPN. Frick.

Abies grandis Lindl. Great Silver Fir. Bailey, Hicks, Frick.

Abies holophylla Maxim. Needle Fir. Hicks, Frick.

Abies homolepis Sieb. & Zucc. (*A. brachyphylla,* Maxim) Nikko Fir. Bailey, Pratt, Havemeyer, Frick, Country Life Press. Var: *umbellata,* Wils, Frick. Var. *Tomomi,* Rehd, Frick.

Abies koreana Wils. Korean Fir. Frick, Hodenpyl.

Abies lasiocarpa Nutt. Alpine Fir, Cork Fir. Hicks, Frick. Var: *arizonica* Lemm., Frick, Bailey, Hicks; *arizonica glauca* SPN, Frick.

Abies magnifica A. Murr. Red Fir. Frick.

Abies mariesii Mast. Maries Fir. Frick.

Abies montigena Hort. Country Life Press.

Abies nephrolepis Maxim (A Veitchii Lindl.) Frick, Hodenpyl. Var. *Chlorocarpa* SPN, Frick.

Abies nobilis Lindl. Var: *glauca* Beiss, Blue Noble Fir; *argentea,* Beiss (?). Frick.

Abies Nordmanniana Spach. Nordmann Fir. Pratt, Matheson, DeForest, Frick, Hodenpyl, Tiffany, Bailey, Hicks, Havemeyer. Var: *aurea spicata* Hort. Frick.

Abies numidica De Lanney. Algerian Fir. Frick.

Abies pectinata DC. (*alba,* Mill). Silver Fir. Frick, Bailey, Hicks, Havemeyer. Var: *pyramidalis* Voss, Matheson, Frick; *pendula,* Asch and Graebn, Frick.

Abies pindrow Spach. (*A. Webbiana* Lindl.) Pindrow Kashmir Fir. Frick.

Abies Pinsapo Boiss. Spanish Fir. Bailey, Hicks, Dana Island, Havemeyer, Frick. Var: *glauca* Beiss-Blue Spanish Fir, Frick, Hicks.

Abies recurvata Mast. Szechuen Fir. Frick, Country Life Press.

Abies sachalinensis Mast, Sakhalin Fir. Frick, Hodenpyl, Bailey. Var: *nemorensis,* Hort., Frick.

Abies sibirica Ledeb. (*pichta* Forbes.) Siberian Fir. Hicks, Frick.

Abies spectabilis SPN. (*Webbiana* Lindl.) N. W. Himalayan Fir. Frick.

Abies squamata Mast. Flaky Fir, W. China. Frick.

Abies Veitchi Murr. Veitch Fir. Frick, Bailey, Hicks, Dana Island, Havemeyer, Country Life Press. Var: *olivacea*, Shiras. Var: *"baluweiss"* (?), Frick.

Abies Wilsonii Hort. Frick, Hodenpyl.

Araucaria Bidwillii Hook. Bunya-bunya. Frick.

Araucaria excelsa. R. Br. Norfolk Island Pine. Havemeyer, Frick.

Araucaria imbricata Par. *A. araucana* Koch.) Monkey Puzzle. Frick.

Cedrus atlantica Manetti var. *glauca*, Manetti. Atlas Cedar. Pratt, Bailey, DeForest, Hodenpyl, Havemeyer, Frick, Country Life Press.

Cedrus Deodara Loud. Deodar Cedar. Havemeyer, Dana Island, Frick.

Cedrus Libani Loud. Cedar of Lebanon. Havemeyer, Dana Island, Pratt, DeForest, Frick. Vars: *brevifolia* Hook, *"aurea"* (*glauca* Carr?), *Sargentii pendula* SPN, Frick.

Chamaecyparis lawsoniana Parl. Lawson Cypress. Frick, Bailey, Hicks, Havemeyer, Dana Island; var: *glauca* Beiss, *Triomphe de Boskoop Cypress*, Bailey; var: *erecta glauca* Beiss, Blue Column cypress, Bailey; vars: *Veitchii glauca* SPN, *"Hollandi"* SPN, *argentea* Beiss, *filifera* SPN, *filifera glauca* SPN, *erecta viridis* SPN, Green Columnar Cypress, *alumi* SPN, Scarab cypress; *alumi glauca* SPN; *"albokessen"* SPN; *tamaricifolia* SPN; *Forsteckiana* SPN, Frick.

Chamaecyparis leptoclada Andely. Retinospora, Frick.

Chamaecyparis nootkatensis Sudw. Nootko Cypress, Bailey. Var: *glauca* Beiss. Blue Nootka Cypress, Bailey, Frick.

Chamaecyparis obtusa Sieb. & Zucc. Hinoki Cypress. Frick, Bailey, Hodenpyl, DeForest, Hicks. Var: *lycopodioides* Carr, Clubmoss Retinospora, *nana* Carr, Frick and Country Life Press; Dwarf Hinoki, *Filicoides* Beiss, Fernspray Retinospora, *pygmaea* Carr, Pygmy hinoki Cypress, Bailey,

Frick; vars: *aurea* Beiss, *gracilis* Nash, Frick and Country Life Press; *gracilis aurea* Beiss, Frick and Country Life Press, *aurea youngii* Nash; *crippsii*, Rend; *tetragona aurea* Nicholls; *lycopodioides* Korean SPN, Frick and Country Life Press; *filicoides* Korean SPN, Frick and Country Life Press; *ericoides* Boehmer (Sander's Retinospora), Frick; var: *nana pygmaea compacta* Hort.; var. *globosa*, Hort., Country Life Press; var. *Youngii*, Hort. (Young's Japanese Cypress, Country Life Press; *compacta* Hartw. and Ruempl., Country Life Press; *erecta* Beiss, Country Life Press.

Chamaecyparis pisifera Sieb. & Zucc. Sawara Cypress. Hodenpyl, Frick, Tiffany, Bailey, Hicks, Pratt. Vars: *aurea* Carr. (Golden Hinoki Cypress), Hodenpyl, Bailey, Willys, Frick, Tiffany, Country Life Press; *filifera* Beiss (Thread Retinospora), Hodenpyl, Bailey, Frick, Country Life Press; *squarrosa* Beiss and Hochst (Moss Retinospora), Hodenpyl, Bailey, Frick; *plumosa* Beiss (Plume Retinospora), Matheson, Frick, Country Life Press; *plumosa aurea* Japanese golden plumed Cypress, Country Life Estate; *filifera aurea* Beiss, Golden Japan cypress; *filifera aurea pendula* Drooping Japan Cypress, Country Life Press. Vars: *nana variegata* SPN; *filifera aurea* Beiss; *filifera aurea Fulleri* SPN; *Filifera nanae* SPN; *plumosa viridis* SPN; *plumosa argentea* Beiss; *plumosa aurea* Beiss; *plumosa cristata* SPN; *squarrosa minima* SPN; *squarrosa veitchii* SPN; *squarrosa Seiboldi* SPN; *squarrosa sulphurea* Beiss; *squarrosa dumosa* SPN (dwarf), Frick.

Chamaecyparis thyoides Britt. White Cedar. Frick, Dana Island. Tiffany, Bailey, Hicks. Var. *ericoides* Sudw. Cedar Retinospora. Bailey.

Cryptomeria japonica D. Donn. Common Cryptomeria. Bailey, Hodenpyl, Hicks, Havemeyer, Pratt, Country Life Press. Var. *dacrydioides* Carr. Frick; *cristata* Beiss, Frick; var. *Lobbi* Carr. Bailey, Frick; *"selaginoides"* SPN, Frick; var. *Lobbii* Hort., Country Life Press.

Cryptomeria Tomasuz Hort. Japanese Cedar. Country Life Press.

Cunninghamia lanceolata Hook. China Fir. Havemeyer, Frick.

Cupressus arizonica Greene. Arizona Cypress. Bailey, Frick. Var. *bonita* Lemm. Smooth Cypress. Frick.

Cupressus goveniana SPN (*Californica* Carr.) Gowen Cypress. Frick.

Cupressus lusitanica Mill. Portuguese Cypress. Frick. Vars. *Benthami* Carr. (Bentham Cypress) *Knightiana* Rehd. Knight Cypress, Frick. *glauca* Lam. Frick.

Cupressus Macnabiana Murr. MacNab Cypress. Frick.

Cupressus macrocarpa Hartw. Monterey Cypress. Havemeyer, Frick. Var. *lutea* Webster; Yellow MacNab Cypress, Frick. var. *variegata* SPN, Frick. var. *guadalupensis* Mast. Guadalupe Cypress, Frick.

Cupressus sempervirens L. Italian Cypress. Frick. Var. *horizontalis* Gord. Frick.

Cupressus torulosa Don. Bhutan Cypress. Frick.

Juniperus californica Carr. California Juniper. Frick.

Juniperus chinensis L. Chinese Juniper. Havemeyer, Bailey, Hicks, Frick, Country Life Press. Var. *pyramidalis* Carr. (Column Chinese Juniper.) Bailey, Hicks; var. *Pfitzeriana* Spaeth (Pfitzer Juniper), Bailey, Hodenpyl, Hicks, Frick, Pratt, DeForest, Country Life Press; var. *albovariegata* Veitch (Whiteleaf Chinese Juniper), Frick, Bailey; var. *foemina* Gord., Havemeyer, Frick; *aurea* Young, Frick; var. *japonica* Wilm. Japanese Juniper, Country Life Press; var. *erecta* Hort., Country Life Press. Var: *columnaris* SPN, *neaborensis* Beiss, *Fortunei* Beiss, *"Kaidsuko"* SPN, *Japonica* Vilm., *Japonica procumbens* SPN, *pendula* SPN, *Virginalis* SPN, *Virginalis aurea* SPN, *Virginalis variegata* SPN, *Virginalis variegata* SPN, *Virginalis globosa* SPN, *Virginalis globosa aurea* SPN, *Sargentii* Henry, Frick.

Juniperus conferta Parl. (*J. litoralis* Max.) Shore juniper. Country Life Press.

Juniperus communis L. Common Juniper. Bailey, Hicks, Eugenics Record Office Grounds C. S. H., Havemeyer, Frick;

var. *hibernica* Gord. (Irish Juniper), Hicks, Country Life Press; *montana* Ait. (Mountain Juniper), Hicks, Eugenics Record Office; *suecica* Loud. (Swedish Juniper), Bailey, Hicks, Frick; *depressa* Pursh (Prostrate Juniper), Hicks, Country Life Press, Frick; *aurea* Carr., Frick; *nana aurea* SPN; *fastigata* SPN; (Irish Juniper) *oblongapendula* Carr; *compacta* SPN; *montana* Ait. Frick; *Juniperus conferta* Parl. (Shore Juniper) Bailey, Hodenpyl, Hicks, Frick; *aureo-spica* Rehd. Country Life Press.

Juniperus excelsa Bieb. Greek Juniper. Havemeyer, Hodenpyl, Hicks; var. *stricta* Rollisson (Spiny Greek Juniper), Bailey, Hicks, Frick, Hodenpyl, Country Life Press.

Juniperus foetidissima Hort. Country Life Press.

Juniperus horizontalis Moench. Creeping Juniper. Frick, Havemeyer, Hicks, Bailey, Davenport; var. *Douglasii* Rehd. (Waukegan Juniper), Bailey, Hodenpyl; var. *glauca* SPN Blue Prostrate Savin. Country Life Press; *"Hills Russian"* SPN. Frick.

Juniperus Japonica Hort. Japanese Juniper. See *J. Chinensis* L.

Juniperus macrocarpa Sibth. Plumb Juniper. Frick.

Juniperus pachyphloea. Torr. Alligator Juniper. Bailey, Frick.

Juniperus phoenicea L. Phoenician Juniper. Frick.

Juniperus procera Hochst. African Juniper. Frick.

Juniperus procumbens Sieb. Frick. Var. *variegata* SPN, Frick.

Juniperus rigida Sieb. and Zucc. Needle Juniper. Bailey, Hicks, Frick. Country Life Press.

Juniperus sabina L. Savin. Pratt, DeForest, Frick, Hodenpyl, Hicks, Bailey, Havemeyer, Country Life Press; var. *tamariscifolia* Ait. (Tamarix Savin) Hodenpyl; *prostrata* SPN, Frick.

Juniperus scopulorum Sarg. Colorado Juniper. Hodenpyl, Bailey, Frick.

Juniperus squamata Lamb, Frick. Prostrate Juniper. Country Life Press; var. *Meyeri* Rehd. (Meyer Juniper), Bailey, Hicks, Havemeyer, Frick; var. *procumbens* SPN *Fargesii*

Rehd. and Wils. Frick and Country Life Press; *Wilsonii* Rehd. Frick, Country Life Press.

Juniperus tamariscaefolia Hort. Country Life Press. Var. *Argentea* (*glauca*) Carr., *elegantissima* Hochst; *Canaertii* Sengel. Frick. Var. *Schotti* Gord., *pyramidalis* Carr., *pyramidiformis* D. Hill, *viridis columnaris* SPN, *pendula* Carr., *tripartita* R. Smith; *plumosa* Rehd.; *reptans* Beiss, Frick.

Juniperus virginiana L. Red Cedar. Matheson, Bailey, Hicks, Havemeyer, Pratt, Frick, Country Life Press; var. *Kosteri* SPN (Koster Red Cedar), DeForest, Hodenpyl, Frick, Hicks; *tripartita* R. Smith. Country Life Press; var. *barbadensis* Gord. Bermuda Juniper, Frick; var. *Schottii* Gord. Country Life Press.

Ketelleeria davidiana Beiss. W. China. Frick.

Larix dahurica Turcz. Dahurican Larch. Frick.

Larix eurolepis Henry. Frick.

Larix decidua Mill. European Larch. Havemeyer, Matheson, DeForest, Hodenpyl, Hicks, Bailey, Frick. Var. *pendula* Kuntze, Frick.

Larix laricina K. Koch (L. *americana*, Michx.) Tamarack, Frick.

Larix leptolepis Murr. (L. *Kaempferi*, Sarg.) Japanese Larch. Hicks, Bailey, Havemeyer, Pratt, Frick.

Larix Lyalli Parl. Lyall Larch. Frick.

Larix occidentalis Nutt. Western Larch.

Larix potanini Batol (*L. thibetica* Franch) China Larch. Frick.

Larix Wilson "(No. 10508)." Frick.

Libocedrus chilensis Endl. Chilean Incense. Frick. Var: *viridis* SPN, Frick.

Libocedrus decurrens Torr. California Incense. Cedar, Havemeyer, Frick.

Picea Alcockiana Carr. (P. *bicolor*, Mayr.) Alcock Spruce. Bailey, Hicks, Havemeyer, Dana Island, Frick.

Picea ascendens Patschke. West China Spruce. Frick.

Picea asperata Mast. West China Spruce. Frick, Country Life Press, Hodenpyl; var. *notabilis* Rehd. & Wilson. Frick,

Country Life Press; *ponderosa* Rehd. and Wilson, Frick.
Country Life Press; var. *Balfouriana* Hort., Country Life Press.
Picea aurantiaca Mast. West China Spruce. Frick.
Picea Balfouriana Rehd. and Wilson. W. China Spruce. Frick.
Picea brachytyla Pritz. West China Spruce. Frick.
Picea Breweriana Wats. Oregon Weeping Spruce. Frick.
Picea canadensis BSP. (*P. glauca*, Voss.) White Spruce. Hicks, Bailey, Frick, Hodenpyl, Willys, Matheson, Havemeyer; var. *albertiana* Sarg. (Alberta Spruce), Hicks, Bailey; var. *caerulea* Rehd. (silver white spruce), Matheson, Frick, *aurea-nana* SPN, Frick; var. *albertiana conica* SPN, *albertiana Webbiana* SPN, *Engelmanni* SPN, Frick.
Picea complanata Mast. West China Spruce. Frick.
Picea Engelmanni (Engelm.) Engelmann Spruce. Bailey, Frick, DeForest, Hicks, Havemeyer, Dana Island, Country Life Press; var. *glauca* Beiss, (Blue Engelmann Spruce). Bailey, Frick.
Picea excelsa Link (*P. Abies* Karst) Norway Spruce. Tiffany, Bailey, Havemeyer, Hicks, Kahn, Pratt, Frick, Country Life Press; var. *compacta* Nash. (Globe Norway spruce), Matheson, Frick; var. *inverta* Hort.; var. *dumosa* Hort.; var. *Maxwelli* Nash; var. *pygmaea* Rehd. Pigmy Norway Spruce; var. *nana* Nash. Country Life Press. Vars: *aurea* Nash, *inversa* Nash, *pyramidalis* Voss, *conica* Th. Fries, *barryi* Nash, *gregoryana* Nash, *maxwelli* Nash, *accrona* SPN, *Ellwangeriana* Rehd.; *parviformis* Rehd.; *pumila* Nash, *pumila nigra* Nash, *Remontii* Rehd, *"sieboldii"* SPN, *monstrosa* Rehd, *monstrosa pygmaea* SPN, *Nidiformis* Rehd, *Ohlendorfi* SPN, *Merkii* Rehd., *brevifolia* SPN, *clanbraziliana* Th. Fries, Frick, Country Life Press; *mictosperma* Rehd., *procumbens* Rehd, *echiniformis* SPN, Frick; *pendula Nash*, Frick.
Picea glauca Voss. White Spruce. Country Life Press.
Picea Glehnii Mast. Sakhalin Spruce. Frick.
Picea heterolepis Rehd. & Wilson. West China spruce. Frick.

Picea jezoensis Maxim. Yeddo Spruce, Frick. Var. *Honodoensis* Rehd. (Hondo spruce), Frick.

Picea Koyamai Shiras. Havemeyer, Hodenpyl, Frick.

Picea likiangenis Pritz. West China Spruce. Frick.

Picea mariana BSP (German) Black Spruce. Frick, Country Life Press. Var. *Doumetti* Sudw., Frick.

Picea Maximowiczi Regel. Japanese Bush Spruce. Hicks, Frick.

Picea Meyeri Rehd. and Wils. N. China Spruce. Frick.

Picea montigena Mast. West China Spruce. Frick.

Picea obovata Ledeb. Siberian Spruce. Hodenpyl, Hicks, Frick.

Picea Omorika Bolle. Serbian Spruce. Bailey, Hicks, Pratt, Havemeyer, Frick, Country Life Press. Var. *pendula* SPN. Frick.

Picea orientalis Carr. Oriental spruce. Bailey, Hicks, Matheson, Havemeyer, Country Life Press, Pratt, Frick. Var. *nana* Carr., dwarf oriental spruce Carr. Frick, Country Life Press.

Picea polita Carr. Tigertail spruce. Matheson, Hicks, Bailey, DeForest, Pratt, Frick, Country Life Press.

Picea pungens Engelm. Colorado Spruce. Frick, Pratt, Hicks, Matheson, Bailey, Havemeyer, Hodenpyl, Country Life Press. Var. *glauca* Beiss, Colorado Blue Spruce. Frick, Bailey, Matheson. Var. *Kosteri pendula* SPN. Frick; *argentea* Beiss, Country Life Press.

Picea purpurea Mast. West China spruce. Frick.

Picea retroflexa Mast. West China spruce. Frick, Country Life Press.

Picea rubra Link. Red Spruce. Frick. Var. *virgata* Rehd., *monstrosa* SPN. Frick.

Picea Sargentiana Rehd. & Wils. West China Spruce. Frick.

"Picea Schneider No. 455" SPN. West China Spruce. Frick, Hodenpyl.

Picea Schrenkiana Fisch and Mey. Schrenk Spruce. Hicks, Frick. Var. *"Wilsoni* No. 11249?" Frick.

Picea sitchensis Carr. Sitka Spruce. Bailey, Frick.

Picea Smithiana Beiss. Himalayan Spruce. Dana Island, Havemeyer, Frick.

Picea "yunnanensis SPN. West China Spruce. Frick.

Pinus "aristata" SPN. Bristlecone Pine. Bailey, Hicks, Frick.

Pinus Armandi Franch. Armand Pine. Bailey, Hicks, Frick.

Pinus attenuata Lamm. (P. *tuberculata* Gord.) Knob-Cone Pine. Frick.

Pinus Ayacahuite Ehrenb. Mexican White Pine. Frick.

Pinus Balfouriana Jeffrey. Foxtail Pine. Bailey.

Pinus Banksiana Lamb. Jack Pine. Bailey, Hicks, Frick, Country Life Press.

Pinus Bungeana Zucc. Lacebark Pine. Hodenpyl, Bailey, Hicks, Frick.

Pinus canariensis C. Smith. Canary Pine. Havemeyer, Frick.

Pinus caribea Morelet. Swamp Pine. Frick.

Pinus cembra L. Swiss Stone Pine. Bailey, Hicks, Havemeyer, Pratt, Frick, Country Life Press. Var. *siberica* Loud. (Siberian Stone Pine), Frick, Country Life Press.

Pinus contorta Dougl. Shore Pine. Frick. Var. *latifolia* Engelm, (Lodge Pole Pine), Frick.

Pinus Coulteri D. Don. Big Cone Pine. Frick.

Pinus densiflora Sieb. and Zucc. Japanese red pine. Hodenpyl, Havemeyer, Dana Island, Bailey, Hicks, Frick. Var. *umbraculifera* Mayr., (Tanyosha Pine), Tiffany, Hodenpyl, Frick, Country Life Press; var. *pendula* Mayr., *oculis draconis* (Dragon Eye Pine), Frick.

Pinus echinata Mill. Shortleaf Pine. Frick.

Pinus edulis (*P. cembroides Zucc.* var. *edulis*, Voss.) Nut Pine. Frick.

Pinus excelsa Wall. Himalayan Pine. Havemeyer, Pratt, Dana Island, Frick.

Pinus flexilis James. Limber Pine. Hodenpyl, Hicks, Bailey, Frick.

Pinus Gerardiana Wall. Frick.

Pinus halepensis Mill. Aleppo Pine. Dana Island. Frick.

Pinus Jeffreyi Balfour. Jeffrey Pine. Hicks, Bailey, Frick.

Pinus koraiensis Sieb. and Zucc. Korean Pine. Bailey, Hicks, Frick.

Pinus Lambertiana Dougl. Sugar Pine. Frick.

Pinus leucodermis Ant. Balkan Gray-Bark Pine. Frick.

Pinus Massoniana Lamb. Dana Island, Havemeyer, Frick.

Pinus monophylla Voss. Single Leaf Pine. Frick.

Pinus montana Mill. Swiss Mountain Pine. Bailey, Pratt, Havemeyer, Frick, Country Life Press; var. *mughus* Zenari (Mugho Pine), Bailey, Tiffany, Willys, Hodenpyl, Hicks, County Life Press, Frick; var. *mughus prostrata* Tubeuf (?), Frick.

Pinus monticola Don. Western White Pine. Bailey, Hicks, Frick.

Pinus muricata Don. Bishop Pine. Frick.

Pinus nigra Arnold. Austrain Pine. Pratt, Bailey, Frick, Hodenpyl, Hicks, Tiffany, Havemeyer; var. *Poiretiana* Asch and Groebn. (Austrian Pine), Hicks, Frick; *austriaca* Asch and Groeben; *cebennensis*, Frick.

Pinus palustris Mill. Longleaf Pine. Frick.

Pinus parviflora Sieb. & Zucc. Japanese White Pine. Bailey, Hodenpyl, Hicks, Frick; var. *glauca* Beiss; *pentaphylla* Henry; *nana* (?), Frick.

Pinus Peuce Griseb. Macedonian Pine. Bailey, Hicks, Frick.

Pinus Pinaster Ait. Cluster Pine. Frick. Var. *Hamiltoni* SPN, Frick.

Pinus pinea L. Italian Stone Pine. Bailey, Frick.

Pinus ponderosa Dougl. Western Yellow Pine. Bailey, Hicks, Frick, Country Life Press.

Pinus pumila Regel. Dwarf Stone Pine. Frick.

Pinus pungens Lamb. Table Mountain Pine. Frick.

Pinus radiata Don. Monterey Pine. Frick.

Pinus resinosa Ait. Red Pine. Bailey, Hicks, Frick, Country Life Press.

Pinus rigida Mill. Pitch Pine. Frick.

Pinus Sabiniana Dougl. Digger Pine. Frick.

Pinus sinensis Lamb. China Pine. Frick.

Pinus strobus L. White Pine. Bailey, Frick, Tiffany, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt; var. *glauca* Beiss (Blue White Pine), DeForest, Frick; var. *nana* Knight, Frick; var. *fastigiata* Beiss, Frick.

Pinus sylvestris L. Scotch Pine. Bailey, Hodenpyl, Hicks, Havemeyer, Pratt, Frick. Var. *Watereri* Rehd. *Argentea* Steven, Frick.

Pinus Taeda L. Loblolly Pine. Frick.

Pinus Thunbergii Parl. Japanese Black Pine. Bailey, Hicks, Dana Island, Havemeyer, Frick, Country Life Press.

Pinus Torreyana Carr. Torrey Pine. Frick.

Pinus "taiwanensis" Hort. Formosa Pine. Frick.

Pseudotsuga douglassi Carr. (P. *taxifolia* Britt) Douglas Fir. Pratt, Hodenpyl, Bailey, Havemeyer, Tiffany, Matheson, Hicks, Frick. Var. "gray" (Colorado) Frick. *glauca* Sudw., *pendula glauca* Schneid, Frick.

Pseudotsuga japonica Beiss. (*Tsuga Japonica* Hort.) Hodenpyl.

Sciadopitys verticillata Sieb. & Zucc. Umbrella Pine. Pratt, Bailey, Tiffany, Hicks, Hodenpyl, Havemeyer, Frick, Country Life Press.

Sequoia gigantea Dc. Giant Sequoia. Frick, Hicks, Havemeyer. Var. *pendula* Lav. *glauca* Otto, Frick.

Sequoia sempervirens Endl. Coast Redwood. Frick. Var. *glauca* R. Smith, Frick.

Taiwania cryptomerioides Hayata. Formosa Taiwania. Frick.

Taxodium distichum Rich. Common Bald Cypress. Matheson, Hodenpyl, Hicks, Bailey, Frick. Var. *"glauca"* Frick, *imbricaria* Nutt. (Common Bald Cypress), Garden City.

Taxodium mucronatum Ten. Montezuma Cypress. Frick.

Thuja globosa Hort. Globe Arbor Vitae. Var. *nana* Hort. Country Life Press.

Thuja koraiensis Nakai. Korean Arbor-vitae. Bailey, Hodenpyl, Frick, Country Life Press.

Thuja occidentalis L. Arbor vitae. Bailey, Tiffany, DeForest. Hodenpyl, Matheson, Hicks, Pratt, Frick. Vars: *Compacta* Beiss, *"Brikerhoffi"* Hort., *Burrowii* Hort., *Douglassii*

aurea Hort., *Riversii* Beiss, *"Reidii"* Hort., *pendula* Gord., Frick, Bailey, DeForest, Frick, Country Life Press; *aureo-variegata* Beiss (*Wareana aurea*), Frick; *Rosenthali* Ohlend (*Lobbi*), Frick, Bailey; *umbraculifera* Beiss, Frick; *dumosa*, Frick; *"pumila,"* Frick; *globosa* Beiss, Frick, Bailey, Matheson, Hodenpyl; *recurva nana*, Frick; *robusta* Carr. (*siberica Wareana*), Frick; *spiralis* Hort., Frick, Country Life Press; *vervaeneana* Henck and Hochst, Frick, Bailey; *columbia* Hort., Frick; *lutea* Gord., Bailey, DeForest, Frick, Country Life Press; *robusta* Carr., Frick, Bailey; var. *"tatarica"* Hort. (little gem), Frick, Bailey; *"Wagneri"* Hort., Frick; *intermedia* Hort., Frick; *ericoides* Beiss and Hochst (Health Arborvitae), Hicks, Bailey, Frick; *Ohlendorffi* Beiss (*Spaethii*), Frick; *filiformis* Beiss (?), Frick; (Threadtwig), Frick; *fastigiata Jaeger* (American Pyramidal Arborvitae), Country Life Press.

Thuja orientalis L. Oriental Arbor Vitae. Pratt, Havemeyer, Frick, Country Life Press. Var: *conspicua* Berckmanns; (*aurea conspicua*) Hort., Frick; *nana aurea* Hort., Frick, Bailey; *aurea Berkmanii* Hort., Frick; *stricta* Loud., Frick, Bailey; *"pyramidalis aurea"* Hort.; *semperaurescens* Nichols, Frick; *flagelliformis* Jacq. (*filiformis*), Frick; *"Wilsoni* (Korean)" Frick; *"Wilsoni aurea"* Frick; *aurea Dauvesse* Bailey, Hodenpyl.

Thuja plicata D. Don. Giant Arborvitae. Bailey, Hicks, Havemeyer. Var. *gigantea* Hort.; *gigantea aurea* Hort. Frick.

Thuja Standishii Carr. Standish Aborvitae. Bailey, Hicks, Dana Island, Frick, Country Life Press.

Thujopsis dolabrata Sieb. & Zucc. False Arborvitae. Bailey, Hicks, Dana Island, Frick.

Tsuga canadensis Carr. Hemlock. Hodenpyl, Kahn, DeForest, Bailey, Hicks, Tiffany, Country Life Press, Matheson, Pratt, Havemeyer. *"Atrovirens"* Hort. compact Canadian Hemlock. Country Life Press; *gracilis* Beiss; *compacta* Senecl; *Sargentii pendula* Hort. (Sargent's Weeping Hemlock) Frick; *Hicksii* Hort., Country Life Press.

Tsuga canadensis Carr. Hemlock. Hodenpyl, Kahn, DeForest. est, Hodenpyl, Hicks, Pratt, Havemeyer, Frick.
Tsuga diversifolia Mast. Japanese Hemlock. Bailey, Hicks, Frick.
Tsuga heterophylla Sarg. Western Hemlock. Frick.
Tsuga Mortensiana Sarg. Mountain Hemlock. Frick. Var. *glauca* Hort., Frick.
Tsuga Sieboldii Carr. Siebold Hemlock. Dana Island, Havemeyer, Frick, Country Life Press.
Tsuga yunnanensis Mast. Yunnan Hemlock. Frick.

SUB-DIVISION II. ANGIOSPERMAE.

CLASS I. MONOCOTYLEDONEAE.

ORDER I. PANDANALES.

TYPHACEAE.

Typha angustifolia L. Narrowleaf Cat-tail. Hodenpyl.
Typha latifolia L. Common Cat-tail. Hodenpyl.

PANDANACEAE.

Pandanus utilis Bory. Common Screwpine. Matheson.
Pandanus Veitchi Dall. Veitch Screwpine. Tiffany, Willys.

ORDER II. HELOBIAE (NAJADALES)

APONOGETONACEAE.

Aponogeton distachyus L. Cape Pond-Weed. Hodenpyl.

ALISMACEAE.

Sagittaria montevidensis Cham. & Schlecht. Giant Arrowhead. Havemeyer.
Sagittaria rigida Pursh. Stiff Arrowhead. Hodenpyl.

ORDER IV. GLUMIFLORAE (GRAMINALES)

GRAMINEAE.

Agrostis palustris Huds. Redtop. Havemeyer.
Arundinaria japonica Sieb. & Zucc. Arrow Bamboo. Tiffany, Matheson.

Arundo Donax L. Giant Reed. Hodenpyl.
Avena sativa L. Oat. Hodenpyl, Davenport.
Bambusa disticha Mitf. Fern Bamboo. Havemeyer.
Bromus macrostachys Desf. Bromegrass. Havemeyer.
Dactylis glomerata L. Orchard Grass. Hodenpyl, DeForest.
Eulalia japonica Trin. var. *gracillima* Hitchc. (*Miscanthus sinensis* Anderss.) Maiden Grass. Anders Eulalia. Hodenpyl.
Festuca glauca Lam. (F. *ovina* L.) Blue Fescue. DeForest, Hicks.
Lolium perenne L. English Rye Grass. Havemeyer.
Notholcus lanatus Nash. Velvet Grass. DeForest.
Pennisetum Ruppelii Steud. Fountain Grass. Havemeyer; var. *cupreum* Hort. Purple Fountain Grass. Matheson.
Phalaris arundinacea L. Reed Canary Grass. Hodenpyl.
Saccharum officinarum L. Sugar Cane in cultivation. C. S. H. vicinity.
Triticum aestivum L. Wheat. C. S. H.
Uniola latifolia L. Broadleaf Uniola. Hodenpyl.
Zea Mays L. Indian Corn. C. S. H. gardens.

CYPERACEAE.

Carex Fraseri Andrews. Fraser Sedge. Hodenpyl.
Cyperus alternifolius L. Umbrella Sedge. Matheson.
Cyperus esculentus L. Chufa. Havemeyer.

ORDER V. PRINCIPES.

PALMACEAE.

Chrysalidocarpus lutescens Wendl. Matheson.
Cocos (*Syagrus*) *Weddellina* Becc. Weddel Palm. Willys.
Howea Belmoreana Becc. Belmore Palm. Tiffany, Willys, Matheson.
Howea Forsteriana Becc. Forster Palm. Tiffany, Willys.
Latania (*Livistona*) *Commersoni* Gmel. Latania. Matheson.
Loroma amethystina Cook (?) (*Seaforthia elegans*) Matheson, Willys.

Phoenix reclinata Jacq. Senegal Date Palm. Matheson.
Phoenix Roebelini O'Brien. Roebelen Palm. Tiffany, Willys.

ORDER VII. SPATHIFLORAE (ARALES).

ARACEAE.

Acorus Calamus L. Sweet Flag. Hodenpyl.
Alocasia indica Schott. Giant Taro. Tiffany.
Anthurium Scherzerianum Schott. Common Anthurium. Tiffany.
Arisaema triphyllum (L) Schott. Jack-in-the-Pulpit. Hodenpyl.
Calla palustris L. Wild Calla. Hodenpyl.
Colocasia esculenta Schott. Elephants-Ear. Dasheen, Tiffany.
Orontium aquaticum L. Golden club. Hodenpyl.
Philodendron verrucosum Math. & Havemeyer.
Peltandra virginica (L) Kunth. Virginia Arrow-Arum. Hodenpyl.
Zantedeschia aethiopica Spreng. Calla. Tiffany, Willys.
Zantedeschia Elliottiana Engler. Golden Calla. Willys, Kahn, Bailey.

ORDER VIII. FARINOSAE (XYRIDALES)

COMMELINACEAE.

Tradescantia bracteata Small. Bracted Spider wort. Tiffany.
Tradescantia fluminensis Vell. Wandering Jew. Havemeyer.
Tradescantia virginiana L. Virginia Spider wort. Hodenpyl, Hicks, Pratt.

ORDER IX. LILIIFLORAE (LILIALES)

LILIACEAE.

Agapanthus africanus Hoffmg. (*A. umbellatus*) African Lily. Matheson.
Allium canadense L. Meadow Garlic. Bailey.
Allium Moly L. Lily Leek. Hodenpyl.
Anthericum Liliago L. St. Bernard Lily. DeForest, Hodenpyl.

Asparagus officinalis var. *altilis* L. Common Asparagus. Hodenpyl, DeForest.

Asparagus plumosus Baker. Fern Asparagus. Tiffany, Willys, Matheson, Kahn, Pratt.

Asparagus Sprengeri Regel. Willys, Matheson, Bailey, Kahn, Tiffany, Pratt.

Aspidistra lurida Hort. (*A. elatior* Blume) Common Aspidistra. Willys, Tiffany, Pratt, Havemeyer.

Brodiaea uniflora Baker. Spring-Star-Flower. Hodenpyl.

Calochortus Catalinae Wats. Catalina Mariposa. Hodenpyl.

Calochortus luteus Dougl. Var: *vestae* Hort. (?) Vesta Mariposa. Hodenpyl.

Calochortus venustus Benth. Var: Butterfly Tulip, *El Dorado*. Hodenpyl.

Camassia Cusicki Wats. Cusick Camass. DeForest.

Camassia Quamash Greene. Common Camas. Hodenpyl.

Chionodoxa Luciliae Beiss. Glory-of-the-snow. Matheson, DeForest, Hodenpyl, Havemeyer, Pratt.

Chlorophytum elatum R. Br. Matheson.

Clintonia borealis Raf. Bluebeard. Hodenpyl.

Clintonia umbellulata (Michx.) Morong. Speckled Clintonia. Hodenpyl.

Colchicum autumnale L. Autumn Crocus. Pratt, Havemeyer.

Convallaria majalis L. Lily-of-the-Valley. Bailey, Hodenpyl, DeForest, Matheson, Tiffany, Hicks, Pratt, Havemeyer.

Dracaena Sanderiana Sander. Tiffany.

Dracaena deremensis Engler. Pratt.

Eremurus himalaicus Baker. Himalayan-Desert Candle. Bailey, Havemeyer.

Eremurus robustus Regel. Pratt.

Erythronium albidum Nutt. White Trout lily. Hodenpyl.

Erythronium americanum Smith. Common Trout lily. DeForest, Hodenpyl.

Erythronium Dens-Canis L. Dog-Tooth Violet. Pratt. Var: *album* Hort. Var: *roseum* Hort. Hodenpyl.

Fritillaria imperialis L. Crown-imperial. Bailey, Tiffany, Hodenpyl, Havemeyer.

Fritillaria meleagris L. Checkered Fritillary. Hodenpyl, Havemeyer, Pratt.

Funkia ovata Spreng (*Hosta caerulea* Tratt.) Hodenpyl.

Funkia subcordata Spreng. (*Hosta plantaginea* Aschers) Day Lily. Havemeyer.

Galtonia candicans Decne. Summer Hyacinth. Matheson, Havemeyer, Pratt.

Hemerocallis aurantiaca Baker. Orange Day Lily. Pratt, Havemeyer.

Hemerocallis citrina Baroni. Citron Day Lily. Hodenpyl.

Hemerocallis Dumortieri Mort. Early Day Lily. Hodenpyl, DeForest, Hicks, Bailey.

Hemerocallis flava L. Yellow Day Lily. Matheson, Kahn, Hodenpyl, Pratt, DeForest, Havemeyer, Tiffany, Bailey, Hicks, Country Life Press.

Hemerocallis fulva L. Common Orange Day-Lily. Hodenpyl, Pratt. Var. *"Kwanso"* Hort. Hodenpyl.

Hemerocallis minor Mill. Hodenpyl, Country Life Press.

Hemerocallis Middendorffi Tratt. Amur Day Lily. DeForest, Hodenpyl, Hicks.

Hemerocallis ochroleuca Hort. Country Life Press.

Hemerocallis Thunbergii Baker. Matheson, Tiffany, DeForest, Pratt, Havemeyer, Kahn, Hodenpyl, Bailey, Hicks, Country Life Press.

Hosta caerulea Tratt. Blue Plantain lily. Tiffany, Matheson, Hodenpyl, DeForest, Hicks, Havemeyer.

Hosta Fortunei Bailey. Fortune Plantain-Lily. Havemeyer.

Hosta lancifolia Tratt (*undulata*, Bailey) Lanceleaf plantain lily. Tiffany, Matheson, DeForest, Hodenpyl, Hicks.

Hosta plantaginea Aschers. Large White Plantain-Lily. Matheson, DeForest, Tiffany, Hodenpyl. Var: *grandiflora* Hort. Hodenpyl, Hicks, Country Life Press.

Hosta Sieboldiana Engler. Cushion Plantain Lily. Matheson, Kahn, Hodenpyl, Havemeyer, Pratt.

Hyacinthus orientalis L. Common Hyacinth. Havemeyer.

Kniphofia corallina Hort. (*K. Macowanii* Baker) Coral Torch Lily. Bailey, Hodenpyl, Hicks.

Kniphofia Uvaria Hook. Common Torch Lily. Matheson, Hodenpyl. Var: *Pfitzeriana* (Bonfire Torchlily.) Hodenpyl.

Lapageria rosea Ruiz and Pav. Red Chile-Bells. Havemeyer.

Leucocrinum montanum Nutt. Sand lily of Colorado. Hodenpyl.

Lilium auratum Lindl. Golden-banded Lily. Bailey, Tiffany, Willys, Matheson, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt, DeForest.

Lilium Brownii F. E. Brown, Brown's Lily. Havemeyer.

Lilium canadense L. Canada Lily. Bailey, Willys.

Lilium candidum L. Madonna Lily. Tiffany, Willys, Matheson, Kahn, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt, Country Life Press.

Lilium chalcedonicum L. Scarlet Turks-Cap Lily. Havemeyer.

Lilium croceum Chaix. Orange Lily. Havemeyer.

Lilium elegans Thunb. Hodenpyl, Havemeyer.

Lilium Grayi Wats. Grays Lily. Hodenpyl.

Lilium Hansoni Leicht. Hanson Lily. Hodenpyl, Havemeyer.

Lilium Henryi Baker. Henry Lily. Bailey, DeForest, Havemeyer, Pratt.

Lilium Humboldti Roezl. & Leicht. Humboldt Lily. Hodenpyl, Havemeyer.

Lilium japonicum Thunb. Japanese Lily. Havemeyer.

Lilium longiflorum Thunb. Easter Lily. Havemeyer.

Lilium Martagon L. Martagon Lily. Bailey, Hodenpyl, Havemeyer.

Lilium monadelphum Marsh & Bieb. Caucasian Lily. Hodenpyl.

Lilium pardalinum Kellog. Leopard Lily. Havemeyer.

Lilium philadelphicum L. Orange cup Lily. Hodenpyl.

Lilium regale Wils. Royal Lily. Matheson, DeForest, Hodenpyl, Bailey, Hicks, Havemeyer, Pratt.

Lilium rubellum Baker. Rubellum Lily. DeForest, Havemeyer.

Lilium Sargentiae Wils. Sargent Lily. Havemeyer.

Lilium speciosum Thunb. Speciosum Lily. DeForest, Hodenpyl, Havemeyer, Pratt. Var: *Melpomene* Hort. Willys.

Lilium superbum L. American Turkscap Lily. Hodenpyl, Matheson. Var: *Carolinianum* Chapin. Hodenpyl.
Lilium tenuifolium Fisch. Coral Lily. DeForest, Hodenpyl, Bailey, Havemeyer.
Lilium testaceum Lindl. Nankeen Lily. DeForest, Havemeyer, Pratt.
Lilium tigrinum Ker. Tiger Lily. Tiffany, DeForest, Hodenpyl, Hicks, Bailey, Havemeyer.
Lilium Washingtonianum Kellogg. Washington Lily. Hodenpyl, Havemeyer, Hicks, Bailey, Havemeyer.
Maianthemum bifolium Hort. (*M. convallaria* Weber). Hodenpyl, Tiffany, DeForest.
Medeola viginica L. Cucumber-Root. Hodenpyl.
Muscari botryoides Mill. Common Grape-Hyacinth. Hicks, Havemeyer, Pratt.
Ophiopogon japonicus Ker. Japanese Snake beard. Matheson. Var: *jaburan aureus variegatus* Hort. Goldstripe Jaburan. Matheson.
Ornithogalum nutans L. Hodenpyl, Pratt.
Ornithogalum umbellatum L. Common star-of-Bethlehem. Bailey, Tiffany, DeForest, Hodenpyl.
Paradisea iliastrum Bert. St. Bruno-Lily. Hodenpyl.
Polygonatum biflorum (Walt.) Ell. Small Solomon's Seal. DeForest, Matheson, Hodenpyl, Tiffany, Hicks.
Polygonatum majus Hort. Hodenpyl.
Polygonatum commutatum (R. & S.) Dietr. Great Solomon Seal. Hodenpyl.
Puschkinia scilloides var. *libanotica* Beiss. Hodenpyl.
Rohdea japonica Roth. Havemeyer.
Sansevieria thyrsiflora Thunb. Havemeyer.
Scilla bifolia L. Twinleaf Squill. DeForest, Hodenpyl.
Scilla hispanica Mill. Spanish Squill. DeForest, Hodenpyl, Havemeyer.
Scilla nonscripta Hoffm. & Link. Common Blue Squill. Tiffany, Kahn, DeForest, Hodenpyl.
Scilla sibirica Andr. Siberian Squill. DeForest, Hodenpyl, Havemeyer, Pratt.

Smilacina racemosa (L) Desf. False Solomon Seal. Bailey, Hodenpyl.

Smilax officinalis H. B. K. Havemeyer.

Stenanthium robustum Wats. Feather fleece. Bailey, Matheson.

Tricyrtis hirta Hook. Hairy Toad Lily. Hodenpyl.

Trillium cernuum L. Nodding Trillium. Hodenpyl.

Trillium erectum L. Purple Trillium. Tiffany, Matheson, DeForest, Hodenpyl, Bailey.

Trillium grandiflorum (Michx.) Salisb. Snow Trillium. Bailey, DeForest, Hodenpyl, Country Life Press.

Trillium ovatum Pursh. Pacific Trillium. Hodenpyl.

Trillium sessile L. Rea Wake Robin. Country Life Press.
Var: *giganteum* Torr. California Trillium. Hodenpyl.

Trillium stylosum Nutt. Rose Trillium. Hodenpyl.

Trillium undulatum Willd. Painted Trillium. Country Life Press.

Tulipa elusiana Vent. Lady Tulip. Pratt.

Tulipa Kaufmanniana Regel. Water-Lily Tulip. Pratt.

Tulipa—Horticultural varieties.

Aphrodite, Dar. Kahn.
Cardinal Manning, Bre. Kahn.
Clara Butt, Dar. Kahn, Matheson.
Earncombe Sanders, Dar. Kahn.
Inglescombe Pink, Cot. Matheson.
La Tristesse, Dar. Kahn.
Inglescombe Yellow, Cott. Matheson.
La Tulipe Noire, Dar. Kahn.
Mrs. Moon. Cot, Kahn.
Rev. H. Ewbank, Dr. Kahn.

Uvularia grandiflora Sm. Big Merrybells. Hodenpyl, Country Press.

Veratrum viride Ait. American False Hellebore. Hodenpyl.

Yucca aloifolia L. Spanish-Bayonet. Hodenpyl.

Yucca filamentosa L. Adam's Needle. Hicks, Tiffany, Fish Hatchery, C. S. H., DeForest, Pratt, Havemeyer, Matheson, Bailey, Country Life Press.

Yucca glauca Nutt. Soapweed Yucca. Matheson.

AMARYLLIDACEAE.

Agave americana L. Century Plant. Tiffany.
Clivia miniata Regel. Scarlet Kafir Lily. Pratt.
Galanthus Cilicicus Baker. Hodenpyl.
Galanthus Elwesii Hook. Giant Snowdrop. Pratt, Havemeyer, Hodenpyl.
Galanthus nivalis L. Snowdrop. Havemeyer, Hodenpyl, Pratt.
Hippeastrum vittatum Herb. Havemeyer.
Hymenocallis macrostephana Baker. Spider Lily. Havemeyer.
Hypoxis hirsuta (L.) Coville. Goldeye Grass. Hodenpyl.
Leucojum aestivum L. Summer Snowflake. DeForest, Hodenpyl.
Leucojum autumnale L. Hodenpyl.
Leucojum vernum L. Spring Snowflake. DeForest, Hodenpyl, Pratt.
Lycoris squamigera Maxim. Amaryllis. Bailey, Hicks, Havemeyer.
Narcissus biflorus Curt. Primrose Peerless. Havemeyer.
Narcissus bulbocodium L. Petticoat Daffodil. Hodenpyl.
Narcissus giganteus Hort. Hodenpyl.
Narcissus incomparabilis Hill. Halfskirt Daffodil. Hodenpyl, Pratt, Havemeyer.
Narcissus juncifolius Lag. Havemeyer.
Narcissus poeticus L. Poets' Narcissus. Matheson, Hodenpyl, Tiffany, Willys, Havemeyer, Pratt. Var: *ornatus* Hort. (Early Poets Narcissus). Matheson, Willys, Tiffany.
Narcissus Pseudo-Narcissus L. Daffodil. Bailey, Tiffany, C. S. H. village, Willys, Pratt.
Narcissus Tazetta L. Polyanthus Narcissus. Pratt.
Narcissus triandrus L. Havemeyer.
Nerine sarniensis L. (Sarniense Herb.) Guernsey Lily. Matheson, Havemeyer.

IRIDACEAE.

Belamcanda chinensis DC. Blackberry-Lily. C. S. H. vicinity. Hodenpyl.
Crocus biflorus Mill. Scotch Crocus. Havemeyer, Pratt.

Crocus susianus Ker. Cloth-of-Gold Crocus. Havemeyer.
Crocus vernus All. Common Crocus. Havemeyer, Pratt.
Freesia refracta Klatt. Havemeyer. Var: *alba* Baker. Willys, Tiffany; *"General Pershing,"* Tiffany, Willys; *Purity,* Willys.
Gladiolus Colvillei Sweet. Havemeyer.
Gladiolus gandavensis Van Houtte. Havemeyer.
Gladiolus Lemoinei Hort. Havemeyer.
Gladiolus primulinus Baker. Primrose Gladiolus. Willys, Havemeyer.
Gladiolus—Horticultural varieties:
Alice Tiplady, Prim. (Kund. 1915) Matheson.
America (Chi. 1906) Tiffany, Willys, Matheson.
Attraction, Prim. (Chaut. 1921) Willys.
Baron J. Hulat (Lem. 1896) Willys.
Bluejay (Groff 1904) Tiffany, Willys.
Ida Vann (Kund. 1913) Matheson.
Kunderd Glory (Kund. 1911) Matheson.
Loveliness, Prim. (Chaut. 1921) Willys.
Mrs. Dr. Norton (Kund. 1915) Willys.
Mrs. Francis King (Cob Vaug. 1906) Willys.
Mrs. Frank Pendleton (Kund. 1913) Willys.
Peace (Groff 1899) Matheson.
Prince of Wales (Van z. 1913) Matheson.
Schwaben (Pfit. 1913) Tiffany.
War (Groff-Cowee 1909) Matheson.
Iris atropurpurea Baker. Black purple Iris. Hodenpyl.
Iris cristata Air. Crested Iris. DeForest, Hodenpyl, Hicks, Matheson, Country Life Press. Var: *lacustris* Hort. Hodenpyl.
Irish flavescens DC. Havemeyer.
Iris foetidissima L. Gladwin Iris. Hodenpyl.
Iris fulva Ker. Hodenpyl.
Iris Germanica L. German Iris. Tiffany, Matheson, DeForest, Hodenpyl, Willys, Hicks, Havemeyer, Pratt. Var: *florentiana* L. Havemeyer. Var: *L'Avenir* Hort. Hodenpyl.
Iris hexagona Walt. Dixie Iris. Hodenpyl. Var. *lamancei* Hort. Hodenpyl, Matheson.
Iris Japonica Thunb. Fringed Iris. Matheson, DeForest, Hodenpyl, Havemeyer, Pratt.

Iris Kaempferi Sieb. (*I. laevigata* Fisch and Meyer.) Matheson, DeForest, Hodenpyl, Hicks, Pratt.
Iris laevigata Fisch and Meyer. Japanese Iris. Hodenpyl, Davenport, Havemeyer, Matheson.
Iris longipetala Herb. Coast Iris. Hodenpyl.
Iris missouriensis Nutt. Rocky Mountain Iris. Hodenpyl.
Iris ochroleuca L. (*I. orientalis* Mill) Yellow bond Iris. Hodenpyl, Havemeyer.
Iris pallida Lam. Sweet Iris. Havemeyer, Pratt.
Iris Pseudacorus L. Yellowflag Iris. Hodenpyl, Kahn, Havemeyer.
Iris pumila L. Tiffany, DeForest, Hodenpyl, Hicks, Havemeyer.
Iris reticulata Bieb. Netted Iris. Hodenpyl.
Iris sibirica L. Siberian Iris. Tiffany, Matheson, DeForest, Hodenpyl, Kahn, Havemeyer, Pratt.
Iris susiana L. Mourning Iris. Hodenpyl.
Iris verna L. Vernal Iris. Hodenpyl, Hicks, Country Life Press.
Iris versicolor L. Blueflag Iris. Hodenpyl.
Iris xiphioides Ehrh. English Iris. Hodenpyl.
Iris Xiphium L. Spanish Iris. Matheson, Hodenpyl.
Iris—Horticultural varieties:

Albert Victor, TB (1885) Matheson.
Apollon, TB (Lum. 1840) Hodenpyl.
Aurea, TB (Jacq. 1830) Hodenpyl.
Azure, Jap. (Chi. 1919) Matheson.
Beauty TB (1860) Matheson.
Blue Jay TB (Farr 1915) Matheson.
Blue King Sib. (Col. by Barr) Matheson.
Blue Stone DB (Per. 1903) Matheson.
Cameleon TB (Lmn. 1840) Matheson.
Celeste TB (Lmn. 1855-58) Matheson, Hodenpyl.
Citrea DB (G. & K. 1899) Matheson.
Delight TB (Sturt. 1918) Matheson.
Emperor Sib. (Named by Wol.) Matheson.
Eugene Sue TB (Lmn. 1848) Hodenpyl.
Favourite TB (1874) Matheson.
Flavescens, Matheson.

Florentine Blue, Kahn, Tiffany, Matheson, Kahn, Hodenpyl.
Gajus TB (G. & K.) Matheson.
Gold Bound Jay (Named by Hal. about 1885) Matheson.
Gracchus TB (Ware 1884 or 1887) Matheson.
Hector TB (Lmn. 1840) Hodenpyl.
Hiawatha TB (Farr 1913) Matheson.
Ignacite TB (Lmn. 1859) Hodenpyl.
Inco TB (Farr. 1922) Matheson.
Jacquesiana TB (Lmn. 1840) Hodenpyl.
James Boyd TB (Farr. 1915) Matheson.
Japanesque TB (Farr. 1922) Matheson.
Jordaens, Hodenpyl.
Lactea Sib. (1876) Matheson.
Lemon TB (Lmn. 1840) Hodenpyl.
Libaudi TB (Lmn. 1840) Hodenpyl.
Lord Wolseley Spur. (1890) Matheson.
Lorely TB (G. & K. about 1909) Matheson.
Louis Van Houtte TB (Lmn. 1840) Hodenpyl.
Maori King TB (Ware 1890) Matheson.
Mars Jap (Hal about 1885) Matheson.
Mary Garden TB (Farr. 1913) Matheson.
Mary Gray TB (Farr. 1913) Matheson.
Massasoir TB (Farr. 1916) Matheson.
Mme. Chereau TB (Lmn. 1844) Hodenpyl.
Monnieri Spur., Hodenpyl.
Monspur Spur. (Fos.) Hodenpyl.
Navaio TB (Farr. 1913) Matheson.
Nightfall Jap. (Chi.) Matheson.
Oriental TB (Farr. 1913) Matheson.
Othello Eng., Matheson.
Pallida dalmatica, Matheson.
Pancrace TB (1854) Hodenpyl.
Paul'ine TB (Farr. 1913) Matheson.
Paxatawny TB (Farr. 1913) Matheson.
Perry Blue Sib. (Per. 1912) Matheson.
Pocohontas TB (Farr. 1915) Matheson.
Powhatan TB (Farr. 1913) Matheson.
Princess Louise DB (Per. 1903) Matheson.
Purple King TB, Matheson.
Quaker Lady TB (Farr. 1909) Matheson.
Queen of May TB (Sal. before 1859) Matheson.
Red Cloud TB (Farr. 1913) Matheson.
Red Riding Hood TB (Koch. 1922) Matheson.

Red Riding Hood Jap. (Hal. about 1855) Matheson.
Reine des Belges TB (Lmn. 1848) Matheson.
Robert Craig Jap. (Hal. about 1885) Matheson.
Samson TB (Lmn. 1840) Hodenpyl.
Sapho TB (Lmn. 1840) Hodenpyl.
Sea Gull Jap. (Hal. about 1885) Matheson.
Sea Gull TB (Farr. N) Matheson.
Seminole TB (Farr. 1920) Matheson.
Shadow Jap. (Hal. about 1885) Matheson.
Silver King, Florentine Iris, Hodenpyl.
Snow Queen Sib. (Berr. about 1900) Matheson, Kahn.
Spuria Alba Spur., Hodenpyl.
Swatara TB (Farr. 1910) Matheson.
Toledo Jap. (Chi.) Matheson.
Victorine TB (Lmn. 1840) Matheson.
Windham TB (Farr. 1909) Matheson.
Wyoming TB (B. & A. 1917) Matheson.

Ixia maculata L. Spotted Ixia. Havemeyer.
Sisyrinchium angustifolium Mill. Common Blue-Eyed Grass. Hodenpyl.
Tritonia cosmaeflora Le Moine. Horticultural varieties, Crocos. Hodenpyl. *George Davison, Golden West, Martagon,* DeForest.
Watsonia iridifolia Ker. Iris leaf Bugle Lily. Havemeyer.

ORDER X. SCITAMINEAE (SCITAMINALES).

MUSACEAE.

Musa Ensete Gmel. Abyssinian Banana. Tiffany.
Musa paradisiaca L. Var. *sapientum* Kuntze. Common Banana. Tiffany.

CANNACEAE.

Canna indica L. Indian Shot. Horticultural varieties: *Antoine Crozy, Beacon, Dr. E. Avkernecht, Duke of Marlborough, Fanal.* Matheson.

MARANTACEAE.

Maranta bicolor Ker. Havemeyer.
Maranta Closoni Hort. Closon Maranta. Tiffany.

ORDER XI. MICROSPERMAE (ORCHIDALES).

ORCHIDACEAE.

Calanthe vestitia Lindl. Havemeyer.
Calopogon pulchellus RBR. Grass-Pink Orchid. Hodenpyl.
Cattleya labiata Lindl. Havemeyer.
Cattleya Mossiae Hook. Havemeyer.
Cattleya Trianae Lindl. & Reichb. Havemeyer.
Cymbidium Lowianum Reichb. Havemeyer.
Cypripedium acaule Ait. Pink Lady Slipper. DeForest, Hodenpyl, Country Life Press.
Cypripedium insigne Wall. Tiffany.
Cypripedium parviflorum Salisb. Small Yellow Ladyslipper. DeForest, Hodenpyl.
Cypripedium spectabile Swartz. Showy Ladyslipper. Tiffany, DeForest, Hodenpyl, Country Life Press.
Dendrobium nobile Lindl. Willys.
Goodyera pubescens R. Br. Downy Rattlesnake Plantain. Hodenpyl.
Goodyera repens R. Br. Creeping Rattlesnake Plantain. Tiffany, Hodenpyl.
Habenaria blephariglottis (Willd.) Torr. White Fringe-Orchis. Hodenpyl.
Habenaria bracteata (Willd.) R. Br. Satyr Orchid. Hodenpyl.
Habenaria ciliaris (L.) R. Br. Yellow Fringe-Orchid. Hodenpyl.
Habenaria Hookeri Torr. Hooker Orchid. Hodenpyl.
Habenaria psycodes (L.) Sw. Small Purple-Fringe-Orchid. Hodenpyl.
Laelia grandis var. *tenebrosa* Lindl. and Paxt. Havemeyer.
Liparis liliifolia Rich. Richard Lily, Twayblade. Hodenpyl.
Orchis spectabilis L. Showy Orchis. Hodenpyl.
Pogonia ophioglossoides (L) Ker. Rose Pogonia. Hodenpyl.
Stanhopea Lowii Hort. Tiffany.

CLASS II. DICOTYLEDONAE.

SUB-CLASS ARCHICHLAMYDEAE.

ORDER III. SALICALES.

SALICACEAE.

Populus alba L. White Poplar. Bailey, Tiffany, Willys, DeForest, Hodenpyl. Var. *balleana* Hort. Balleana popular. Hodenpyl.

Populus deltoides Marsh. Southern Cottonwood. Willys, Hicks.

Populus grandidentata Michx. Large Toothed Aspen. C. S. H. vicinity.

Populus Lasiocarpa Oliver. Havemeyer.

Populus Maximowiczi Henry. Japanese Poplar. Bailey, Hicks.

Salix alba L. White Willow. Havemeyer. Var: *regelis* Hort. Royal Willow. Hodenpyl.

Salix babylonica L. Weeping Willow. Bailey, DeForest, Hicks, Willys, Pratt, Havemeyer. Var: *Japonica* Thunb. Japanese weeping willow. Tiffany.

Salix caprea L. Goat Willow. Bailey, Hicks.

Salix fragilis L. Brittle Willow. Willys, C.S.H. vicinity. Havemeyer.

Salix brachycarpa Hort. Hodenpyl.

Salix incana Schrank. Rosemary Willow. Pratt.

Salix irrorata Anders. Blue Stem Willow. Bailey, Hodenpyl.

Salix pentandra L. Laurel Willow. Tiffany, Hodenpyl, Matheson, Hicks, Willys.

Salix purpurea L. Purple Osier. Havemeyer.

Salix tristis Ait. Dwarf Willow. Matheson.

Salix viminalis L. Osier Willow. Havemeyer.

Salix vitellina L. Yellow Willow. Hodenpyl, along streams and roadsides, C. S. H. Var: *britzensis* Hort. (Bronze Golden Willow) Bailey, Hodenpyl; var. *aurea* Salisb. (Russian Golden Willow) Bailey, Hodenpyl.

ORDER IV. GARRYALES

GARRYACEAE.

Garrya ovata Hort. Hodenpyl.

ORDER V. MYRICALES.

MYRICACEAE.

Comptonia asplenifolia Ait. (*Myrica asplenifolia* L.) Sweet-fern. Matheson, DeForest, Hodenpyl, Hicks.

Myrica carolinensis Mill. Northern Bayberry. Bailey, DeForest, Tiffany, Hodenpyl, Hicks.

Myrica Gale L. Sweet Gale. Matheson, Hodenpyl.

ORDER VIII. JUGLANDALES.

JUGLANDACEAE.

Hicoria laciniosa Engler and Graebn. Shellbark Hickory. Tiffany, Matheson, Hodenpyl, Bailey.

Hicoria ovata (Mill) Britton. (*Carya ovata* (Mill) K. Koch.) Shagbark Hickory. Hicks.

Hicoria Pecan Britt. (*Carya pecan* Aschers & Graebn) Pecan. Havemeyer.

Juglans cathayensis Dode. Chinese Walnut. Hodenpyl.

Juglans cinerea L. Butternut. Bailey, Hodenpyl.

Juglans nigra L. Black Walnut. Bailey, Matheson, Hicks, Willys.

Juglans regia L. Persian Walnut (English walnut of common speech) Bailey, Hodenpyl; var. *japonica* Hort. Bailey, Hodenpyl, Matheson; *praeparturiens* Hort. (Bush Walnut) Hodenpyl.

Juglans Sieboldiana Maxim. Japanese Walnut. Havemeyer.

ORDER XI. FAGALES.

BETULACEAE.

Alnus incana (L.) Moench. Speckled Alder. Hodenpyl; var. *laciniata* Willd. Cutleaf Alder. Bailey.

Betula alba L. (var. *pendula Roth*) European White Birch. Bailey, Hodenpyl, Tiffany, DeForest, Kahn, Willys, Havemeyer, Pratt, Matheson. Var: *fastigiata* Hort. Pyramidal White Birch. Matheson. Var. *laciniata* Hort. Cutleaf Weeping Birch. Bailey.

Betula chinensis Hort. Hodenpyl.
Betula fontinalis Sarg. Water Birch. Hodenpyl.
Betula lutea Michx. Yellow Birch. Bailey, Hodenpyl, Hicks.
Betula nigra L. River Birch. Bailey.
Betula papyrifera Marsh. Canoe Birch. Kahn, Hodenpyl.
Betula populifolia Ait. Bray Birch. Hodenpyl, Hicks.
Betula sailoana Hort. Hodenpyl.
Carpinus Betulus L. European Hornbeam. Hicks, Bailey, Kahn, Havemeyer.
Carpinus betulus L. var. *pyramidalis* Dipp. Pyramid Hornbeam. Bailey.
Carpinus caroliniana Walt. Hornbeam. Pratt, Hodenpyl, Bailey, Hicks.
Corylus americana Walt. Hazelnut. Hicks, Hempstead plain, Bailey, Hodenpyl, Matheson.
Corylus avellana L. Filbert. Hodenpyl, Hicks, Havemeyer; var. *atropurpurea* Hort. Bailey.
Corylus colurna L. Tree Hazelnut. Hodenpyl, Hicks.
Ostrya virginiana (Mill.) K. Koch. American Hornbeam. Hicks.

FAGACEAE.

Castanea dentata Borkh. American Chestnut. Havemeyer.
Castanea japonica Blums (*C. Crenata* Sieb. & Zucc.) Japanese Chestnut. Bailey, Hodenpyl.
Castanea mollissima Blume. Hairy Chestnut. Hodenpyl.
Castanea pumila Mill. Chinquapin. Bailey, Hodenpyl.
Castanea sativa Mill. Spanish Chestnut. Tiffany, Matheson, DeForest, Hodenpyl.
Fagus americana Sweet American Beech. Tiffany, Matheson, Willys, Bailey, Hodenpyl, Hicks, DeForest. Var. *atropurpurea* Copper Beech. Hodenpyl, Pratt, Havemeyer.
Fagus Sieboldi Endl. Japanese Beech. Bailey.
Fagus sylvatica L. European Beech. Matheson, Bailey, Tiffany, DeForest, Hodenpyl, Hicks, Pratt. Var. *heterophylla* Loud. Fernleaf Beech. Bailey, Hicks; var: *pendula* Loud. Weeping Beech. Bailey, Willys, Matheson; var. *purpurea*

Ait. Purple Beech L. Matheson, Bailey, Tiffany, Hicks; var: *purpurea Riversi* Hort. Rivers Beech. Bailey; var: *tricolor* Bailey, Havemeyer. Var. *pyramidalis* Kirchn, Havemeyer.

Quercus alba L. White Oak. Tiffany, DeForest, Hodenpyl, Hicks, Bailey.

Quercus bicolor Willd. Swamp White Oak. Hicks, Bailey.

Quercus Cerris L. Turkey Oak. DeForest, Havemeyer.

Quercus coccinea Muench. Scarlet Oak. DeForest, Hodenpyl, Bailey, Hicks.

Quercus dentata Thunb. Daimyo Oak. Pratt, Havemeyer.

Quercus falcata Michx. Southern Red Oak. Hodenpyl.

Quercus ilicifolia Wang. Scrub Oak. Hicks.

Quercus imbricaria Michx. Laurel Oak. Hicks.

Quercus macrocarpa Michx. Mossycup Oak. Hodenpyl, Hicks.

Quercus marilandica Muench. Blackjack Oak. Bailey, Hicks.

Quercus palustris Muench. Pin Oak. Tiffany, Bailey, DeForest, Matheson, Hodenpyl, Hicks.

Quercus Phellos L. Willow Oak. Hicks, Hodenpyl, Matheson.

Quercus Prinus L. Chestnut Oak. Bailey, Tiffany, DeForest, Hodenpyl, Hicks.

Quercus Robur L. (*Q. pedunculata* Ehrb.) English Oak. Bailey, Hodenpyl, Matheson, Hicks, Pratt. Var: *Filicifolia* Lem. (Fernleaf English Oak) Bailey; var: *fastigiata* DC. (Pyramidal English Oak) Matheson, Hicks, Bailey.

Quercus rubra L. Common Red Oak. Bailey, Tiffany, DeForest, Hodenpyl, Hicks.

Quercus variabilis Blume. Bristletcoth Oak. Hodenpyl.

Quercus stellata Wang. Post Oak. Hicks.

Quercus velutina Lam. Black Oak. Hicks.

ORDER XII. URTICALES.

ULMACEAE.

Celtis occidentalis L. Hackberry. Bailey.

Ulmus alata Michx. Winged Elm. Hodenpyl.

Ulmus americana L. American Elm. Bailey, Tiffany, DeForest, Matheson, Hodenpyl, Hicks, Havemeyer, Pratt.

Ulmus campestris L. English Elm. Bailey, C. S. H. vicinity. Willys, Tiffany, Matheson, DeForest.
Ulmus glabra Huds. Scotch Elm. Bailey, Hodenpyl, Hicks.
Ulmus hollandica Mill. Holland Elm. Bailey. Var: *vegeta* Rehd. (Huntingdon Elm) Hodenpyl.
Ulmus parvifolia Jacq. Corkbark Elm. Bailey, Tiffany, Hicks.
Ulmus pumila L. Dwarf Asiatic Elm. Havemeyer.
Zelkova serrata Makino. Sawleaf Zelkova. Bailey, Hicks.

MORACEAE.

Broussonetia papyrifera Vent. C. S. H. vicinity. Bailey.
Cannabis sativa L. Hemp. C. S. H. vicinity.
Ficus carica L. Common Fig. Matheson.
Ficus elastica Roxb. Rubber Plant. Tiffany, Matheson, Havemeyer.
Ficus pumila L. Climbing Fig. Tiffany, Matheson.
Humulus Lupulus L. European Hop. Laboratory grounds, C. S. H., Havemeyer.
Maclura pomifera Schneid. Osage Orange. Matheson, Hodenpyl, Hicks.
Morus acidosa Hort. Acid Mulberry. Hodenpyl, Hicks.
Morus alba L. White Mulberry. Pratt. Var: *tatarica* Louden. Russian Mulberry. Bailey, Tiffany, Hodenpyl.
Morus nigra L. Black Mulberry. Matheson.
Morus rubra L. Red Mulberry. Matheson, C. S. H. vicinity.

ORDER XIII. PROTEALES.

PROTEACEAE.

Grevillea robusta Cunn. Silk-Oak. Tiffany, Willys, Pratt.

ORDER XV. ARISTOLOCHIALES.

ARISTOLOCHIACEAE.

Aristolochia Sipho L. Her. (*macrophylla* Lam.) Dutchman's Pipe. Matheson, Havemeyer.
Asarum canadense L. Canada Wild Ginger. DeForest, Hodenpyl.

ORDER XVI. POLYGONALES.

POLYGONACEAE.

Eriogonum umbellatum Hort. Country Life Press.
Fagopyrum esculentum Gaertn. Common Buckwheat. C. S. H.
Polygonum alpinum All. Alpine Fleece flower. Havemeyer.
Polygonum Auberti L. Henry China Fleece Vine. Hodenpyl, Hicks, Pratt.
Polygonum baldschuanicum Regel. Silver Fleece Vine. Matheson, Bailey, Havemeyer.
Polygonum sachalinense Schmidt. Sacaline. Hodenpyl.
Rheum Rhaponticum L. Rhubarb. Tiffany, Matheson.

ORDER XVII. CENTROSPERMAE.

CHENOPODIACEAE.

Beta vulgaris L. Common Beet. Gardens, C. S. H.
Kochia scoparia Schrad. Kochia. Summer Cypress. Hicks.

AMARANTACEAE.

Amaranthus sp? Amaranth. Willys.
Celosia argentea L. Feather Cockscomb. Willys, Bailey. Var: *cristata* Kuntze, Bailey.
Celosia Huttoni Mart. Hutton Cockscomb. Tiffany.

NYCTAGINACEAE.

Abronia latifolia Esch. Yellow Sand Verbena. Havemeyer.
Bougainvillea glabra Choisy. Lesser Bugainvillea. Havemeyer.

PORTULACACEAE.

Claytonia virginica L. Virginia Springbeauty. DeForest, Hodenpyl.
Lewisia pygmaea Rob. Hodenpyl.
Portulaca grandiflora Hook. Rose Moss. Tiffany, Matheson, Havemeyer.

BASELLACEAE.

Boussingaultia baselloides HBK. Madeira Vine. Matheson.

CARYOPHYLLACEAE.

Arenaria Groenlandica (Retz.) Spreng. Greenland Sandwort. Hodenpyl.

Arenaria Michauxii Hort. Hodenpyl.

Arenaris montana L. Mountain Sandwort. Country Life Press, DeForest.

Arenaria verna L. Var. *caespitosa* Hort. Moss Sandwort. DeForest, Hodenpyl.

Cerastium grandiflorum Waldst. and Kit. Chickweed.

Cerastium tomentosum L. Snow-in-summer, Bailey, Hodenpyl, Tiffany, Matheson, Kahn, DeForest, Hicks, Havemeyer, Pratt.

Dianthus Allwoodii Hort. Hybrid Pink.

Dianthus alpestris Hort. Country Life Press.

Dianthus barbatus L. Sweet William, Bailey, Tiffany, Willys, Matheson, Laboratory grounds, C. S. H., DeForest, Hodenpyl, Hicks, Havemeyer, Pratt.

Dianthus caesius Sn. Cheddar Pink. Country Life Press.

Dianthus Caryophyllus L. Carnation, Matheson. Horticultural varieties:

Belle Washburn (B. & W. 1916) Tiffany.
Enchantress (Fish. 1903) Tiffany.
Enchantress Supreme (Dail. 1913) Tiffany.
Laddie (Dor. 1918) Kahn.
Maine Sunshine (Str. 1919) Kahn, Tiffany.
Matchless (Cot. 1912) Kahn.
White Perfection (or. 1906) Tiffany.
White Wonder (Dor. 1910) Kahn.

Dianthus chinensis L. Hodenpyl, Country Life Press, Havemeyer, Pratt.

Dianthus deltoides L. Maiden Pink, DeForest, Hicks. Var. *alba* Hort, *aloima* Hort, *rubra* Hort, Country Life Press.

Dianthus essexwitch Hort. Country Life Press.

Dianthus fimbriatus Bieb. Havemeyer.

Dianthus Falconeri Hort. Country Life Press.

Dianthus glacialis Haenke. Ice Pink, Havemeyer. Var. *neglectus* Williams, Country Life Press.

Dianthus kamschaticus Hort. Country Life Press.

Dianthus plumarius L. Grass Pink. Matheson, DeForest, Hodenpyl, Bailey, Hicks, Havemeyer, Pratt. Var: *"Her Maj-*

esty," "Mrs. Sinkins," Double White Fragrant Pink, Country Life Press.

Gypsophila cerastioides D. Don. Country Life Press.

Gypsophila elegans Bieb. Common Gypsophila. Pratt, Havemeyer.

Gypsophila muralis L. Cushion Gypsophila. DeForest, Pratt.

Gypsophila paniculata L. Baby's Breath. Bailey, Havemeyer, Tiffany, Willys, Kahn, Matheson, DeForest, Hodenpyl, Hicks, Pratt; var. *florepleno* Hort. (Double Baby's Breath) Tiffany, Matheson.

Gypsophilla repens L. Creeping Gypsophila. DeForest, Hodenpyl, Country Life Press.

Herniaria glabra L. Rupture Wort. Havemeyer.

Lychnis chalcedonia L. Maltese Cross. Bailey, Hodenpyl, Hicks; var. *alba* Hort. (White Maltese Cross) Hodenpyl.

Lychnis Coronaria Desr. Mullein Pink. Matheson, Hodenpyl, Hicks.

Lychnis Flos-cuculi L. Ragged Robin. Hicks, Hodenpyl, DeForest.

Lychnis Flos-Jovis Desr. Flower-of-Jove. Hodenpyl.

Lychnis Viscaria L. Clammy Campion. Matheson, DeForest, Havemeyer.

Sagina subulata Wimm. Pearl Wort. Matheson.

Saponaria ocymoides L. Rock Soap Wort. Matheson, DeForest, Hicks, Havemeyer, Country Life Press.

Saponaria officinalis L. Bouncing Bet. Hodenpyl.

Saponaria Vaccaria L. Cow Herb. Havemeyer.

Silene acaulis L. Moss Campion. Hicks, Country Life Press.

Silene alpestris Jacq. Alpine Catchfly. Hodenpyl, Havemeyer.

Silene Armeria L. Sweet William Catchfly. Havemeyer.

Silene orientalis Hort. (S. *compacta* Fisch.) Oriental Catchfly. Bailey, DeForest.

Silene pennsylvanica Michx. Peat Pink. DeForest, Hodenpyl.

Silene Schafta G. Gmel. Schafta Catchfly. DeForest, Country Life Press.

Stellaria Holostea L. Easter Bells. Havemeyer.

Tunica Saxifraga Scop. Saxifrage Tunic Flower. Hodenpyl, Hicks, Havemeyer, Country Life Press.

ORDER XVIII. RANALES (RANUNCULALES).

NYMPHAEACEAE.

Nelumbo nucifera Gaertn. (*N. Nelumbo*, Druce.) Hindu Lotus. Hodenpyl. Var. *albagrandi* Hort., *flora* Hort., *kermesiana* Hort., *pekinensis* Hort. Hodenpyl.

Nymphaea alba L. var. *candidissima* Hort. Large European Water Lily. Bailey, Hodenpyl.

Nymphaea gracilis Hort. White Mexican Water Lily. Hodenpyl.

Nymphaea Lotus Zucc. L. White Egyptian Lotus. Tiffany.

Nymphaea odorata Ait. American Water Lily. Hodenpyl.

Nymphaea tuberosa Paine. Magnolia Water Lily. Hodenpyl. Var. *Richardsoni* Conard. Hodenpyl.

Nymphaea-horticultural varieties: Flesh Marliac (*Marliacea carnea* Hort.), Hodenpyl. Gladstone (*Gladstoniana* Hort.), DeForest. "James Bryden," DeForest, Hodenpyl, Marliac (*Marliacea* Hort.), DeForest, Hodenpyl. Red Magnolia (*tuberosa*), Hodenpyl. Robinson (*robinsoni* Hort.), Hodenpyl. Rose Magnolia (*tuberosa rosea* Hort.), Hodenpyl. White Marliac (*Marliacea albida* Hort.), Hodenpyl. William Dooque, Hodenpyl. Yellow Marliac (*Marliacea chromatella* Hort.), Hodenpyl.

TROCHODENDRACEAE.

Cercidiphyllum japonicum Sieb. Zucc. Katsura-tree. Hicks, Havemeyer. Var. *sinensis* Hort.; Chinese Katsura Tree. Hodenpyl.

RANUNCULACEAE.

Aconitum autumnale Reichb. Autumn Monkshood. DeForest.

Aconitum Fischeri Reichb. Azure Monkshood. DeForest. Var. *Wilsonii* Davis. Violet Monkshood. DeForest, Havemeyer, Country Life Press.

Aconitum Napellus L. Aconite. DeForest, Matheson, Hicks, Hodenpyl, Country Life Press.

Actaea alba (Ait.) Willd. White Baneberry. Matheson, Hodenpyl.
Actaea rubra (Ait.) Willd. Red Baneberry. Hodenpyl.
Adonis vernalis L. Spring Adonis. DeForest, Hodenpyl, Pratt.
Anemone canadensis L. Meadow Anemone. Matheson, DeForest, Hodenpyl.
Anemone fulgens Gay. Scarlet Anemone. Hodenpyl.
Anemone hupehensis Hort. Bailey.
Anemone japonica Sieb. & Zucc. Japanese Anemone.
Anemone patens L. var. *Nuttalliana* Gray. American Pasque Flower. Hodenpyl.
Anemone Pulsatilla L. European Pasque Flower. Hodenpyl, Havemeyer. Var. *rubra* Hort. Country Life Press.
Anemone sylvestris L. Snowdrop Anemone. Hodenpyl.
Anemonella thalictroides (L.) Spach. Hodenpyl.
Aquileqia caerulea James. Colorado Columbine. Havemeyer, Matheson, Kahn, DeForest, Hodenpyl, Bailey, Hicks, Pratt.
Aquilegia canadensis L. American Columbine. Kahn, DeForest, Hodenpyl, Tiffany, Hicks, Havemeyer.
Aquilegia chrysantha Gray. Golden Columbine. Matheson, DeForest, Hodenpyl, Hicks, Havemeyer.
Aquilegia flabellata Sieb. & Zucc. Fan Columbine. DeForest. Var. *nana alba* Hort. White Fan Columbine. DeForest.
Aquilegia vulgaris L. European Columbine. Hicks, Havemeyer.
Caltha minor Hort. Hodenpyl.
Caltha palustris L. Marsh marigold. Hodenpyl.
Caltha polypetala Hochst. Great Marsh-marigold. Hodenpyl.
Cimicifuga davurica Maxim. Dahurican Bugbane. Matheson.
Cimicifuga foetida Linn. Var. *Simplex* Reg. Bailey, DeForest, Havemeyer, Pratt.
Cimicifuga japonica Spreng. Bugbane. DeForest.
Cimicifuga racemosa Nutt. Black Snakeroot. DeForest, Pratt, Hodenpyl, Bailey, Hicks.
Cimicifuga simplex Wormsk. Japan Snake Root. Country Life Press.
Clematis crispa L. Curly Clematis. Havemeyer.

Clematis dioscoreifolia Hort. Yamleaf Clematis. Hodenpyl.
Clematis Fremonti Wats. Fremont Clematis. Hodenpyl.
Clematis fusca Turcz. var. *mandschurica* Hort. Hodenpyl.
Clematis heracleaefolia DC. var. *Davidiana* Hemsl. Fragrant Tube Clematis. Bailey. Var. *stans* Hoch, Hodenpyl.
Clematis Jackmani Moore. Pratt, DeForest, Matheson, Hodenpyl, Hicks, Havemeyer. Country Life Press.
Clematis Lawsoniana Anderson, var. *Henryi* Rehd. Country Life Press.
Clematis montana Buch. Ham. Anemone Clematis. DeForest, Hodenpyl, Bailey, Havemeyer.
Clematis orientalis Lam. Yellow clematis. oCuntry Life Press.
Clematis paniculata Thunb. Sweet Autumn Clematis. Tiffany, Matheson, DeForest, Hodenpyl, Hicks, Havemeyer.
Clematis recta L. Ground Clematis. DeForest, Hodenpyl, Havemeyer, Pratt, Country Life Press.
Clematis serratifolia Rehd. Korean Clematis. Hodenpyl.
Clematis tangutica Kershinsky. Golden Clematis. Hodenpyl, Country Life Press.
Clematis texensis Buckl. Scarlet Clematis. Bailey.
Clematis virginiana L. Virgin's Bower. Hodenpyl, Fish Hatchery, C. S. H. Bailey, Hicks.
Coptis trifolia (L.) Salisb. Gold Thread. Hodenpyl.
Delphinium cultorum Voss. Pale blue larkspur. Country Life Press.
Delphinium formosum Boiss and Huet. Hardy larkspur. Bailey, Tiffany, Willys, DeForest, Hicks.
Delphinium grandiflorum L. Siberian Larkspur. DeForest, Hodenpyl, Hicks, Havemeyer, Pratt. Var. *Chinense* Huth. (Slenderlarkspur), Tiffany, Kahn ,DeForest.
Delphinium hybridum Steph. Mountain Larkspur. Matheson.
Delphinium nudicaule Torr. and Gray. Red Larkspur. Hodenpyl.
Delphinium Horticultural varieties:

Belladonna Tiffany, Kahn, DeForest, Willys.
King of Delphiniums. Hodenpyl.

Lamartine. Kahn.
Persimmon. Hodenpyl.
White Siberian. Matheson, Willys.
Sir George Newnes. Hodenpyl.
Beauty of Langport. Hodenpyl.

Eranthis hyemalis Salisb. Winter Aconite. Hodenpyl.
Helleborus niger L. Christmas Rose. Hodenpyl, Havemeyer.
Hepatica acutiloba DC. Sharplobe Hepatica. DeForest, Hodenpyl.
Hepatica triloba Chaix. Round lobe Hepatica. DeForest, Hodenpyl, Hicks.
Hydrastis canadensis L. Goldenseal. Hodenpyl.
Nigella damascena L. Love-in-a-mist. Davenport garden, C. S. H., Bailey.
Nigella hispanica L. Havemeyer.
Paeonia alibiflora Pallas. Chinese Peony. Havemeyer.
Paeonia officinalis L. Common Peony. Willys, Havemeyer.
Paeonia suffruticosa Andr. Tree Peony. Hicks, Bailey, Havemeyer.
Paeonia—horticultural varieties:

Duchesse de Nemours (Gue) Matheson.
Edulis superba (Lemon) Matheson.
Eugene Verdier (Cal.) Matheson.
Festiva Maxima (Miel) Matheson, Kahn.
Floral Treasure (Ros.) Matheson.
Humei Carnea (Gue.) Matheson.
Jeanne d'Arc (Gal.) Matheson.
La Tulipe (Cal.) Matheson.
Lady Leonora Bramwell (Verd.) Matheson.
Mme. Geissler (Cr.) Matheson.
Mme. Jules Elie (Cal.) Matheson.
Mme. Le Moine (Cal.) Matheson.
Modeste Guerin (Gue.) Matheson.
Mons Jules Elie (Cr.) Matheson.

Ranunculus aconitifolius L. Aconite Buttercup. DeForest, Hodenpyl.
Ranunculus asiaticus L. Turbin. Hodenpyl.
Ranunculus fascicularis Muhl. Tufted Buttercup. Hodenpyl.

Ranunculus repens L. Creeping Buttercup. Tiffany, DeForest, Hodenpyl.

Ranunculus septentrionalis Poir. Swamp Buttercup. Hodenpyl.

Syndesmon thalictroides Hoffman. Hodenpyl.

Thalictrum aquilegiflorum L. Columbine Meadow Rue. Matheson, DeForest, Hodenpyl, Havemeyer.

Thalictrum dasycarpum Fisch. and Lall. Purple Meadow Rue. Bailey.

Thalictrum dioicum L. Early Meadow Rue. Hodenpyl.

Thalictrum dipterocarpum Franch. Meadow Rue. Havemeyer, Pratt, DeForest, Country Life Press, Bailey.

Thalictrum glaucum Desf. Dutsy-Meadow Rue. Hodenpyl, Havemeyer.

Thalictrum horticultural varieties:

(*Thalictrum sulfureum* Cy.) Hybrid Meadow Rue. Hodenpyl.

Maidenhair Meadow Rue (*T. minus* L. × *adiantifolium* Hort.) Bailey, Tiffany, Matheson, Hicks, DeForest.

Purple Columbine Meadow Rue (*T. aquilegifolium* L. × *purpureum* Hort.) DeForest, Hodenpyl.

White Columbine Meadow Rue (*T. aquilegifolium* L. × *album* Hort.) DeForest.

Trollius aurantiacus Hort. Hodenpyl.

Trollius asiaticus L. Hodenpyl, Pratt.

Trollius caucasicus Stev. Caucasian Globe flower. Hodenpyl, Bailey.

Trollius europaeus L. Common Globeflower. Matheson, Hodenpyl, Havemeyer, Pratt.

Trollius giganteus Hort. Hodenpyl.

Trollius japonicus Hort. Japanese Globeflower. Hodenpyl (*T. Asiaticus.* L.?)

Zanthorhiza apiifolia L. Her. Shrub Yellowroot. DeForest, Hodenpyl, Bailey.

LARDIZABALACEAE.

Akebia quinata Decne. Five leaf Akebia. DeForest, Pratt, Matheson, Bailey, Hodenpyl, Hicks, Havemeyer.

Decaisnea Fargesii Franch. Hodenpyl.

MENISPERMACEAE.

Asimina triloba Dunal. Papaw. Hodenpyl, Hicks.
Menispermum Dauricum DC. Asiatic Moonseed. Hodenpyl.

BERBERIDACEAE.

Berberis actinacantha Mart. Hodenpyl.
Berberis aggregata Schneid var. *Pratti* Hort. Barberry. Bailey, Hodenpyl. Var. *recurvata* Hort. Hodenpyl.
Berberis Amurensis Rupr. Amur Barberry. Bailey, Hodenpyl.
Berberis asiatica Roxb. Hodenpyl. Var. *japonica* Rehd. Hakodate Barberry. Hodenpyl, Bailey.
Berberis brachypoda Hort. Hodenpyl.
Berberis brevipaniculata Schneid. Shortcluster Barberry. Bailey, Havemeyer.
Berberis buxifolia Poir. Magellan Barberry. Bailey.
Berberis canadensis Mill. Allegheny Barberry. Bailey.
Berberis circumserrulata Hort. Hodenpyl.
Berberis Darwini Hook. Darwin Barberry. Bailey, Havemeyer.
Berberis diaphana Max. Kansu Barberry. Hodenpyl, Bailey, Hicks.
Berberis dictyophylla Franch. Chalkleaf Barberry. Bailey.
Berberis Gagnepaini Schneid. Black Barberry. Bailey, Hodenpyl, Hicks, Havemeyer.
Berberis Gilgiana Hort. Hodenpyl.
Berberis ilicifolia Forst. Holly Barberry. Bailey, Hodenpyl, Matheson.
Berberis Julianae Schneid. Wintergreen Barberry. Bailey, Hodenpyl, Havemeyer.
Berberis Morrisonensis Hort. Hodenpyl.
Berberis Neuberti Lem. var. *latifolia* Hort. Broadleaf Barberry. Bailey.
Berberis notabilis Hort. Hodenpyl.
Berberis Poireti Schneid. Poiret Barberry. Hodenpyl.
Berberis Sargentiana Schneid. Sargent Barberry. Bailey, Hodenpyl, Hicks, Havemeyer.

Berberis reflecta Hort. Hodenpyl.
Berberis sinensis Desf. Chinese Barberry. Bailey.
Berberis stenophylla Mast. Rosemary-Barberry. Bailey, Havemeyer.
Berberis Thunbergi DC. Japanese Barberry. Bailey, Tiffany, Matheson, Havemeyer, Pratt. Var: *Maximowiczi* Franch and Sav. Coral Barberry. Bailey. Var: *minor* Cy. Bix Barberry. Bailey.
Berberis triacanthophora Hort. Three spine Barberry. Hodenpyl.
Berberis Vernae Schneid. Verna Barberry. Bailey, Hodenpyl.
Berberis verruculosa Hemsl. & Wils. Warty Barberry. Bailey, Hodenpyl, DeForest, Hicks, Havemeyer.
Berberis vulgaris L. European Barberry. Matheson, Bailey, Hicks, Havemeyer. Var: *atropurpurea* Regl. Purple Barberry. Tiffany, Matheson, Bailey.
Berberis Wilsonae Hemsl. Wilson Barberry. Bailey, Hodenpyl, DeForest, Hicks, Havemeyer.
Caulophyllum thalictroides (L.) Michx. Blue Cohosh. Hodenpyl.
Epimedium alpinum Hook? Alpine Epimedium. DeForest, Hodenpyl.
Epimedium macranthum Morr. & Decne. Longspur Epimedium. DeForest.
Epimedium Musschianum Morr. & Decne. Japanese Epimedium. Hodenpyl.
Epimedium pinnatum Fisch. Hodenpyl.
Mahonia Aquifolium Nutt. Oregon Hollygrape. Havemeyer, Matheson, Bailey, Tiffany, DeForest, Hicks, Pratt, Country Life Press.
Mahonia Bealii Fort. (B. *Japonica* Spreng.) Leatherleaf Hollygrape. Havemeyer, Matheson, DeForest, Hodenpyl, Bailey.
Mahonia repens Lindl. Creeping Holly Grape. Havemeyer.
Podophyllum peltatum L. Common May Apple. Hodenpyl.
Vancouveria hexandra Morr. and Decne. Hodenpyl.

MAGNOLIACEAE.

Liriodendron tulipifera L. Tulip-tree. Bailey, Matheson, DeForest, Hodenpyl, Hicks, Willys.

Magnolia acuminata L. Cucumber Tree. Bailey, Davenport, Willys, Hodenpyl, Hicks, Havemeyer, Dana Island.

Magnolia (*conspicua*) *Yulan* Desf. Bailey, DeForest, Hodenpyl, Hicks.

Magnolia Fraseri Walt. Fraser Magnolia. Bailey, Hodenpyl.

Magnolia glauca L. (*Virginiana* L.) Sweet Bay. Bailey, Hodenpyl, Hicks, DeForest, Country Life Press.

Magnolia grandiflora L. Bailey, Hodenpyl, Havemeyer, Dana Island, DeForest.

Magnolia hypoleuca Sieb. & Zucc. Silver Magnolia. Bailey, Hicks, Havemeyer, Dana Island.

Magnolia Kobus Thunb. Kobus Magnolia. Bailey, Havemeyer.

Magnolia macrophylla Mchx. Great Leaved Magnolia. Tiffany. Hicks, DeForest, Havemeyer, Dana Island.

Magnolia parviflora Sieb. & Zucc. Oyama Magnolia. DeForest, Hodenpyl, Bailey.

Magnolia salicifolia Ait. (*M. grandiflora* L) Anise Magnolia. Hodenpyl.

Magnolia Soulangeana Soul. Saucer Magnolia. Matheson, Pratt, Havemeyer, DeForest, Hodenpyl, Bailey, Davenport; var. *speciosa* Hort. (striped saucer magnolia) Hodenpyl; var. *Alexandrian* Hort. (Alexander Magnolia) Hodenpyl; *Lennei* (Lenne Magnolia) Hort. Tiffany, Hodenpyl.

Magnolia stellata Maxim. Star Magnolia. DeForest, Hodenpyl, Hicks, Bailey, Havemeyer, Pratt; var. *stellata rosea* Hort. Pink Star Magnolia. Hodenpyl.

Magnolia Thompsonia Sarg. Thompson Magnolia. Bailey.

Magnolia tripetala L. Umbrella Tree. DeForest, Hodenpyl, Hicks, Bailey, Havemeyer, Dana Island.

Magnolia Watsoni Hook. Watson Magnolia. DeForest, Hodenpyl, Bailey.

Magnolia Wilsoni Hort. Wilson Magnolia. Bailey.

CALYCANTHACEAE

Calycanthus floridus L. Common Sweetshrub. Matheson, Hodenpyl, Hicks.

LAURACEAE.

Benzoin aestivale L. Nees. Spice bush. Matheson, Hodenpyl, Hicks.

Sassafras variifolium Kuntze. Sassafras. Matheson, Bailey, Tiffany, Willys, Hicks.

ORDER XIX. RHOEADALES (PAPAVERALES).

PAPAVERACEAE.

Argemone grandiflora Sweet. Prickle poppy. Bailey.

Bocconia cordata Willd. Pink Plume Poppy. Tiffany, Matheson, DeForest.

Eschscholzia californica Cham. Common California Poppy. Bailey, Tiffany.

Hunnemannia fumariaefolia Sweet. Goldencup or Mexican Tulip Poppy. Bailey.

Meconopsis cambrica Vig. Welsh Poppy. DeForest, Bailey.

Meconopsis Wallichi Hort. Satin Poppy. Bailey.

Papaver bracteatum Lindl. Great Scarlet Poppy. Tiffany, Matheson.

Papaver nudicaule L. Island Poppy. Hicks, Havemeyer, Country Life Press.

Papaver orientale L. Oriental Poppy. Bailey, Tiffany, Hodenpyl, Matheson, Hicks, Havemeyer.

Papaver somniferum L. Opium Poppy. Gardens, C. S. H.

Romneya Coulteri Harv. Coulter Canyon Poppy. DeForest.

Sanguinaria canadensis L. Bloodroot. DeForest, Hodenpyl, Bailey, Hicks.

FUMARIACEAE.

Dicentra canadensis Walp. Squirrelcorn. Hodenpyl.

Dicentra Cucullaria Bern. Dutchman's Breeches. DeForest, Hodenpyl.

Dicentra eximia Torr. Fringed Bleeding heart. Hodenpyl, DeForest, Hicks.

Dicentra formosa Walp. Western Bleeding heart. Hodenpyl.
Dicentra spectabilis Lem. Bleeding heart. Matheson, DeForest, Hodenpyl, Hicks, Havemeyer.

CRUCIFERAE.

Aethionema grandiflorum Boiss and Hohen. Persian Candy Tuft, Country Life Press.
Aethionema pulchellum Hort. Armenian Candy Tuft. Country Life Press.
Aethionema iberidium Hort. Oriental Candy Tuft. Country Life Press.
Alyssum argenteum Vitm. Silver Alyssum. DeForest, Hodenpyl, Tiffany, Country Life Press.
Alyssum maritimum Lam. (*maritima* Desv.) Sweet Alyssum. Kahn, Bailey; var. "Little Gem," Willys, Tiffany.
Alyssum rostratum Stev. Yellow Head. DeForest, Hodenpyl, Matheson est.
Alyssum saxatile L. Golden-Tuft. DeForest, Kahn, Matheson, Hodenpyl, Tiffany, Bailey, Hicks, Havemeyer, Country Life Press. Var: *compactum* Hort. Dwarf Golden-Tuft. DeForest, Hodenpyl.
Arabis albida Stev. Wallcress. Havemeyer. Var: *flore pleno* Hort. Country Life Press.
Arabis alpina L. Alpine Rockcress. Matheson, DeForest, Hodenpyl, Tiffany, Hicks, Havemeyer. Var: *nana compacta* Hort. Dwarf Alpine Rockcress. DeForest, Hodenpyl.
Arabis mollis Stev. Downy Rockcress. Hodenpyl, Country Life Press.
Arabis muralis Bert. Italian Rock Cress. DeForest.
Arabis rosea Hort. Country Life Press.
Armoracia rusticana Gaertn. Mey & Scherb. Horse Radish, C. S. H. vicinity.
Aubrietia deltoidea DC. Havemeyer, Country Life Press. Var: *graeca* Nichols. Greek Aubrietia. *Leichtlini* Nichols. Leichtlin A. Country Life Press. Var. *Moerheimi* Cy. Moerheim A. DeForest.
Brassica Napobrassica Hort. Rutabaga. C. S. H.

Brassica oleracea var. *capitata* L. Cabbage. Gardens C. S. H.
Brassica Rapa L. Turnip. Gardens C. S. H.
Cheiranthus allioni Hort. Wallflower. Matheson, DeForest, Hodenpyl, Bailey, Tiffany.
Cheiranthus Cheiri L. Common Wallflower. Matheson, Bailey, Havemeyer, Pratt.
Dentaria diphylla Michx. Crinkleroot. Hodenpyl.
Dentaria laciniata Muhl. Cut Tooth wort. Hodenpyl.
Draba Fladnizensis Wulf. Havemeyer, Country Life Press.
Draba olympica Sibth. Whitlow Grass. Havemeyer.
Erysimum Perofskianum Fisch & Mey. African Blistercress. Havemeyer.
Erysimum pulchellum J. Gay (*E. rupestre* D. C.) Rockery Bittercress. Hodenpyl, Country Life Press.
Hesperis Matronalis L. Dames Violet. Matheson, DeForest, Escaped, C. S. H., Hodenpyl.
Hutchinsia alpina Hort. Country Life Press.
Iberis gibraltarica L. Gibraltar or Perennial Candy tuft. Matheson, Bailey, Havemeyer, Country Life Press.
Iberis sempervirens L. Evergreen Candy tuft. Kahn, DeForest, Hodenpyl, Hicks, Bailey, Havemeyer, Pratt, Country Life Press; var. *"Little Gem"* Country Life Press.
Matthiola incana R. Br. Stock or Gilliflower. Cultivated, C. S. H. vicinity.
Radicula nasturtium-aquaticum L. Britten & Rendle. Watercress. Hodenpyl.
Raphanus sativus L. Radish. Cultivated in gardens. C. S. H.

RESEDACEAE.

Reseda odorata L. Common Mignonette. Country Life Press, Tiffany, Matheson, Pratt.

ORDER XX. SARRACENIALES.

SARRACENIACEAE.

Sarracenia Drummondi Croom. Drummond Pitcher Plant. Hodenpyl.

Sarracenia flava L. Pitcher Plant. Hodenpyl; var. *picta* Bull (*S. catesbaei* Ell.) Catesby pitcher plant. Hodenpyl.
Sarracenia psittacina Michx. Parrot Pitcher Plant. Hodenpyl.
Sarracenia purpurea L. Common Pitcher Plant. Hodenpyl.
Sarracenia rubra Watt. Sweet Pitcher Plant. Hodenpyl; var. *Sweetii* Mast. Hooded Pitcher Plant. Hodenpyl.

DROSERACEAE.

Dionaea muscipula Ellis. Venus Flytrap. Hodenpyl.
Drosera rotundifolia L. Roundleaf Sundew. Hodenpyl.

ORDER XXI. ROSALES.

CRASSULACEAE.

Echeveria secunda Booth. Tiffany, Havemeyer.
Sedum acre L. Goldmoss. Matheson, DeForest, Hodenpyl, Tiffany, Hicks, Bailey, Havemeyer.
Sedum Aizoon L. Aizoon Stonecrop. Havemeyer.
Sedum album L. White Sedum. DeForest, Hodenpyl, Hicks, Bailey, Country Life Press.
Sedum anglicum Huds. Havemeyer.
Sedum caeruleum Vehl. Blue Sedum. Bailey.
Sedum dasyphyllum L. Leafy Stonecrop. Havemeyer, Country Life Press.
Sedum kamtschaticum Fisch and Mey. Orange Sedum. Bailey, Tiffany, DeForest, Hodenpyl, Hicks.
Sedum lydium Boiss. Lydian Sedum. DeForest.
Sedum pulchellum Michx. Texas Stonecrop. Havemeyer, Country Life Press.
Sedum reflexum L. Jenny Stonecrop. Hodenpyl.
Sedum rupestre L. Havemeyer.
Sedum sempervivoides Fisch. False Houseleck. Havemeyer.
Sedum sexangulare L. Hexagon Stonecrop. DeForest, Hodenpyl, Country Life Press.
Sedum Sieboldii Sweet. Siebold Sedum. Bailey, Matheson, DeForest, Hicks, Havemeyer, Country Life Press.

Sedum spectabile Boreau. Showy Sedum. DeForest, Tiffany, Hodenpyl, Hicks, Havemeyer, Pratt, Country Life Press.
Sedum stoloniferum Gmel. Running Sedum. DeForest, Bailey, Hodenpyl, Hicks, Havemeyer. Var: *spurium* Hort. Country Life Press.
Sedum telephoides Michx. Wild Live-Forever. Hodenpyl.
Sedum ternatum Michx. Mountain Stonecrop. Hodenpyl, Country Life Press.
Sempervivum arachnoidum L. Spider Web Houseleek. DeForest, Country Life Press.
Sempervivum arvernense Lecq. & Lam. Havemeyer.
Sempervivum soboliferum Sims. Hen-and-Chickens. Matheson.
Sempervivum tectorum L. Common Houseleek. DeForest, Hicks, Havemeyer, Country Life Press.

SAXIFRAGACEAE.

Astilbe astilboides Lemoine. Goastbeard Astilbe. Hodenpyl, Matheson, Bailey, Havemeyer.
Astilbe chinensis Franch and Say. Chinese Astilbe. Hicks.
Astilbe Davidii Henry. David Astilbe. Bailey, Hodenpyl, DeForest, Havemeyer, Pratt.
Astilbe gloria Hort. Hodenpyl.
Astilbe koreana Hort. Hodenpyl.
Astilbe grandis Stapf. Var. *rosea* Hort. Country Life Press.
Astilbe japonica Gray. Japanese Astilbe. DeForest, Hodenpyl, Hicks, Havemeyer.
Astilbe rosea Von Wareren and Kruijft. Rose Astilbe. Bailey, Tiffany, DeForest, Hicks.
Astilbe vars. *Peach Blossom* Matheson, *Queen Alexandra* Hodenpyl, *W. E. Gladstone*, Matheson, DeForest.
Carpenteria californica Torr. Havemeyer.
Deutzia discolor Hemsl. Bailey.
Deutzia glabrata Hort. Hodenpyl.
Deutzia gracilis Sieb. & Zucc. Slender Deutzia. Bailey, Tiffany, Willys, Matheson, DeForest, Hicks, Havemeyer, Pratt.
Deutzia parviflora Bunge. Mongolian Deutzia. DeForest.

Deutzia scabra Thunb. Fuzzy Deutzia, Hicks. Var: *crenata* Voss, Bailey, Matheson, DeForest, Hodenpyl. Var. "Pride of Rochester," Bailey.

Deutzia setchuensis French. Szechwan Deutzia. Bailey.

Deutzia-horticultural vars: *Avalanche*, Bailey; *Boule de Neiga* Bailey; *Lemoinei* Cy., Bailey, Tiffany, Matheson, DeForest, Hodenpyl, Hicks.

Heuchera americana L. American Alumroot. Hodenpyl.

Heuchera bracteata Ser. Hodenpyl.

Heuchera brizoides Hort. Country Life Press.

Heuchera sanguinea Engelm. Coral bells. Havemeyer, Matheson, DeForest, Hodenpyl, Hicks, Bailey, Pratt. Var: *gracillima* Hort. (Grass leaf Coral Bells.) Hodenpyl.

Heuchera villosa Michx. Hairy Alumroot. Hodenpyl.

Hydrangea arborescens L. Bailey, Matheson, Hicks, DeForest, Hodenpyl, Pratt, Havemeyer. Var: *grandiflora* Rehd. (Snowhill Hydrangea), Matheson.

Hydrangea Bretschneideri Dipp. Shaggy Hydrangea. Hodenpyl.

Hydrangea cinerea Small. (*H. radiata* Walt.) Ashy Hydrangea. Hodenpyl.

Hydrangea opuloides Koch. Havemeyer. Var: *otaksa*, Sieb and Zucc. Dtaksa Hydrangea. Tiffany, Bailey, Willys. Var: *"General de Vibraye."* Matheson.

Hydrangea paniculata Sieb. Panicle Hydrangea. Tiffany, Matheson, DeForest, Hodenpyl, Willys, Hicks, Bailey, Havemeyer, Pratt.

Hydrangea petiolaris Sieb. & Zucc. Climbing Hydrangea. Hodenpyl, DeForest, Bailey, Hicks, Dana Island (Pratt).

Hydrangea quercifolia Bartram. Oakleaf Hydrangea, Hodenpyl, DeForest, Bailey, Hicks, Dana Island (Pratt).

Hydrangea radiata Walt. Silverleaf Hydrangea, Hodenpyl.

Hydrangea xanthoneura Diels. Yellow vein Hydrangea, DeForest. Var: *Wilsoni* (Wilson Hydrangea), Hodenpyl.

Itea virginica L. Sweetspire. Hodenpyl, Havemeyer.

Jamesia Americana Torr and Gr. Japanese Anemone. Hodenpyl.

Mitella diphylla L. Common Bishop's cap. DeForest, Hodenpyl.
Parnassia asarifolia Vent. Brook Parnassia. Hodenpyl.
Parnassia caroliniana Michx. Carolina Parnassia. Hodenpyl.
Philadelphus coronarius L. Sweet Mock-orange. Matheson, DeForest, Hodenpyl, Bailey.
Philadelphus cymosus Rehd. Havemeyer.
Philadelphus Falconeri Sarg. Star Mock-orange. Bailey.
Philadelphus Gordonianus Lindl. Gordon Mock-orange. Hodenpyl, Bailey.
Philadelphus grandiflorus Willd. (P. *inodoratus*, var. *grandiflorus*, Gray.) Big Scentless Mock-orange. Matheson, Hodenpyl, Hicks.
Philadelphus inodorus L. Scentless Mock-orange. Matheson, Hodenpyl, Pratt.
Philadelphus Lewisi Pursh. Lewis Mock-orange. Hodenpyl.
Philadelphus magdalenae Hort. Magdalena Mock-orange. Hodenpyl.
Philadelphus purpurascens Hort. Purplecup Mock-orange. Bailey, Hodenpyl.
Philadelphia virginalis Rehd. Havemeyer.
Philadelphus Wilsoni Hort. Wilson Mock-orange. Hodenpyl.
Philadelphus Lemoinei Lemoine. Hodenpyl, Hicks, Havemeyer, Pratt. Vars: *Avalanche*, Bailey, Hicks; *Boule l' Argent*, Bailey; *Candelabre*, Bailey, Jack (P. *Schrenki jacki* Hort.) Hodenpyl; *Mont Blanc*, Hicks; *Perle Blanche*, Bailey; *Splendens* (?), Hodenpyl; *Virginal* (?), Bailey, Hodenpyl, Hicks: *Voie Lactee* (?), Bailey.
Philadelphus zeyheri Schrad. Hodenpyl.
Ribes alpinum L. Mountain Currant. Hodenpyl.
Ribes aureum Pursh. Slender Golden Currant. Hodenpyl.
Ribes gordonianum Lem. (*aureum* & *sanguineum*) Gordon Currant. Hodenpyl.
Ribes mescalerium Hort. Hodenpyl.
Ribes odoratum Wendl. Golden Currant. Havemeyer.
Ribes oxycanthoides L. Hodenpyl.
Ribes sanguineum Pursh. Winter Currant. Tiffany, Willys, Hodenpyl.

Ribes vulgare Lam. (*Sativum* Syme) Common Currant. Havemeyer.

Rodgersia podophylla Gray. Bronze leaf. Hodenpyl.

Saxifraga Aizoon Jacq. DeForest, Havemeyer.

Saxifraga arguta Hort. Hodenpyl.

Saxifraga cordata Hort. Hodenpyl.

Saxifraga cordifolia Haw. Heartleaf Saxifrage. Matheson, DeForest, Hodenpyl; var. *purpurea* Hort; *compactum* Hort; *splendens* Hort; *Amos Perry* Hort, Country Life Press.

Saxifraga crassifolia Linn. Leather Saxifrage. Tiffany, DeForest, Hicks. Var: *orbicularis* (Dwarf Leather Saxifrage) Hort. Hodenpyl. *Van Houttei* Hort. Saxifrage. Hodenpyl.

Saxifraga lingulata Bell. Rajah Saxifrage. Hodenpyl, Havemeyer.

Saxifraga sarmentosa L. Strawberry Saxifrage. Havemeyer.

Saxifraga squarrosa Sieber. Crevice Saxifrage. Hodenpyl.

Saxifraga umbrosa L. London-Pride Saxifrage. DeForest, Hodenpyl, Havemeyer.

Saxifraga virginiensis Michx. Virginia Saxifrage. Hodenpyl.

Schizophragnia hydrangeoides Sieb. & Zucc. Japanese Hydrangea Vine. Bailey, Hicks, Havemeyer, Pratt.

Schizophragma integrifolium Oliver. Chinese Hydrangea vine. Matheson.

Tiarella cordifolia Hort. Foam Flower. Country Life Press. Var. *purpurea major*. Red Foam Flower. Country Life Press.

PITTOSPORACEAE.

Pittosporum phillyraeoides DC. Narrow-leaved Pittosporum. Havemeyer.

HAMAMELIDACEAE.

Corylopsis gotoana Hort. Goto. Winterhazel. Bailey, Hodenpyl.

Corylopsis pauciflora Hort. Flowering Hazel. Country Life Press.

Corylopsis spicata Sieb. & Zucc. Spike Winterhazel. Bailey, Hodenpyl.

Fothergilla major Lodd. Large Fothergilla. Hodenpyl.
Hamamelis japonica Sieb. & Zucc. Japanese Witch Hazel. DeForest, Hodenpyl, Hicks, Bailey.
Hamamelis mollis Oliver. Chinese Witch Hazel. Hicks.
Hamamelis vernalis Sarg. Hodenpyl, Hicks.
Hamamelis virginiana L. Witch Hazel. Hodenpyl, Hicks, Bailey, Dana Island, Havemeyer.
Liquidambar formosana Hance. Formosa sweetgum. Hicks.
Liquidambar Styraciflua L. Sweet Gum. Bailey, Willys, DeForest, Tiffany, Hodenpyl, Hicks, Pratt, Havemeyer.
Parrottia persica C. A. Mey. Russian Parrottia. Bailey, Hicks.

PLATANACEAE.

Platanus acerifolia Willd. London Plane. Kahn.
Platanus occidentalis L. American Plane Tree. Bailey, Willys, Matheson, Fish Hatchery, C. S. H., Hodenpyl, Hicks, Havemeyer, Pratt.
Platanus orientalis L. European Plane Tree. Bailey, Willys, Matheson, Hodenpyl, Hicks.

ROSACEAE.

Amelanchier alnifolia Nutt. Saskatoon. Matheson, Bailey, Havemeyer.
Amelanchier canadensis L. Medic Downy Serviceberry. DeForest, Hodenpyl, Bailey, Hicks.
Amelanchier ovalis Medikus. Garden Shadblow. Hodenpyl.
Amelanchier stolonifera Wiegand. Running Shadblow. Hicks.
Amygdalus Davidiana Franch. Chinese Wild Peach. Bailey.
Amygdalus Persica L. (*Prunus persica.* Sieb. & Zucc.) Peach. Hicks, Hodenpyl, Matheson, DeForest, Escaped C. S. H. Havemeyer; var. *alboplena* Hort. Double White Peach. Bailey; var. *nectarina* Hort. Nectarine. Hodenpyl, Matheson, Hicks; var. *rubro plena* Hort. Double Red Peach. Bailey.
Aronia arbutifolia L. Red chokeberry. Matheson, Hicks, Hodenpyl, Bailey, Havemeyer.
Aronia atropurpurea Hort. (*A. floribunda* Ag.) Purple Chokeberry. Bailey, Hicks.

Aronia melanocarpa Spach. Black chokeberry. Hodenpyl, Bailey, Hicks.

Aruncus Sylvester Kostl. Common Goatsbeard. Kahn, Hodenpyl, Havemeyer, Pratt; var. *Kneiffi* Zabel. Cutleaf Goatsbeard. Hodenpyl.

Cotoneaster acutifolia Lindl. Peking Cotoneaster. Hodenpyl, Hicks, Bailey; var. *villosula* Hort. Hodenpyl.

Cotoneaster adpressa Hort. Creeping Cotoneaster. Tiffany, DeForest, Hodenpyl, Hicks, Bailey.

Cotoneaster apiculata Hort. Hodenpyl.

Cotoneaster bullata Hort. Hodenpyl.

Cotoneaster buxifolia Wall. Bailey.

Cotoneaster Dammerii Schneid. Hodenpyl.

Cotoneaster Dielsiana Pritz. Diels Cotoneaster. Hodenpyl, Bailey, Hicks, Havemeyer.

Cotoneaster distochya Hort. (*distichia?*) Hodenpyl.

Cotoneaster divaricata Rehd. and Wils. Spreading Cotoneaster. Hodenpyl, Bailey, Hicks.

Cotoneaster Francheti Bois. Franchet Cotoneaster. DeForest, Hodenpyl, Bailey, Hicks.

Cotoneaster frigida Wall. Himalayan Coloneaster. Hodenpyl, Bailey.

Cotoneaster Harroviana Hort. Hodenpyl.

Cotoneaster Henryana Hort. Hodenpyl.

Cotoneaster horizontalis Decne. Rock Cotoneaster, Hicks, Bailey, Hodenpyl, DeForest, Havemeyer, Pratt; var: *Wilsoni*, Havemeyer, Hodenpyl, Hort; var: *humepusa* Hort, Havemeyer; var: *perpusilla* Hort, Hodenpyl; var: *himalaicus* Hort. Havemeyer.

Cotoneaster hupehensis Rehd. and Wilson. Hupeh Cotoneaster. Hodenpyl, Bailey, Hicks.

Cotoneaster integerrima Medic. European Cotoneaster. Hodenpyl.

Cotoneaster microphylla Wall. Rockspray, DeForest, Hodenpyl, Bailey, Hicks, Havemeyer, Country Life Press. Var: *thymifolia* Koehne, DeForest, Bailey.

Cotoneaster moupinensis Franch. Mupin Cotoneaster. Hodenpyl, Hicks, Bailey.
Contoneaster multiflora Bunge var. *colocarpa* Hort. Hodenpyl, Hicks.
Cotoneaster nitens Hort. Hicks.
Cotoneaster obscura Hort. Hodenpyl.
Cotoneaster praecox Hort. Hodenpyl.
Cotoneaster pyrenaica Hort. Pyrenees Cotoneaster. Bailey, DeForest.
Cotoneaster racemiflora Koch. Var. *soongarica* Schneid. Hodenpyl, Hicks.
Cotoneaster rotundifolia Wall. Roundleaf Cotoneaster. Bailey, Hodenpyl.
Cotoneaster salicifolia Franch. Willowleaf Cotoneaster. Hodenpyl, Hicks. Var: *floccosa* Hort., Hodenpyl.
Cotoneaster Simonsii Baker. Simon's Cotoneaster. Bailey, Hodenpyl, Hicks, Havemeyer.
Cotoneaster tenuipes Hort. Hodenpyl.
Cotoneaster Zabeli Schneid. Hodenpyl, Hicks.
Cotoneaster var. "Forest," Schneider, Hodenpyl.
Crataegus apiifolia Michx. Parsley Hawthorn. Bailey.
Crataegus arkansana Sarg. Arkansas Hawthorn. Bailey, Hodenpyl.
Crataegus Arnoldiana Sarg. Arnold Hawthorn. Bailey, Hodenpyl.
Crataegus Carrieri Vauv. Carriere Hawthorn. Bailey.
Crataegus coccinea L. Thicket Hawthorn. Hodenpyl.
Crataegus cordata Ait. Washington Hawthorn. Bailey, Hodenpyl, Hicks.
Crataegus Crusgalli L. Cockspur Thorn. Bailey, Hodenpyl, Matheson, DeForest, Hicks.
Crataegus Ellwangeriana Sarg. Ellwanger Hawthorn. Bailey, Hicks.
Crataegus fructuosa Hort. West Chester Hawthorn. Bailey.
Crataegus monogyna (Jacq.) var. *alba plena* Hort. Double English Hawthorn, DeForest, Hodenpyl. Var. *rubra plena* Hort. Double Red Hawthorn, DeForest.
Crataegus nitida Sarg. Glossy Hawthorn. Bailey, Hodenpyl.

Crataegus Oxyacantha L. English Hawthorn. Matheson, Kahn, DeForest, Hodenpyl, Bailey, Tiffany, Hicks, Pratt.

Crateagus pinnatifida Bunge. Chinese Hawthorn. Bailey, Hodenpyl.

Crataegus raphiolepsis Hort. Hodenpyl.

Cydonia Japonica Pers. (*Chaenomeles japonica* Lindl.) Flowering Quince. Bailey, Matheson, DeForest, Hodenpyl, Tiffany, Hicks.

Cydonia Maulei Nichols. Lesser Flowering Quince. Bailey; var *superba* Hort. (Ruby Flowering Quince), Bailey.

Cydonia oblonga Mill. Quince. C. S. H. village, Matheson, Hodenpyl, Bailey, Havemeyer.

Dalibarda repens L. DeForest, Hodenpyl.

Exochorda Giraldii Hesse, Havemeyer; var. (*Giraldii Wilsoni* Wilson) Pearlbush. Bailey, Hodenpyl.

Exochorda grandiflora Lindl. (*racemosa* Rehd.) Common Pearlbush. Matheson, DeForest, Hodenpyl, Hicks, Bailey.

Exochorda Korolkowi Lav. Hindustan Pearlbush. Havemeyer.

Filipendula Kamtschatica Rehd. Kamchatka Meadowsweet. Hodenpyl.

Filipendula hexapetala Gilib. (*Ulmaria filipendula* Hill) Dropwort. Hodenpyl.

Filipendula palmata Focke. Siberian Meadowsweet. Hodenpyl, DeForest.

Filipendula rubra Rob. Prairie Meadowsweet. DeForest; var. *venusta* Hort. (Carmine Meadowsweet), Matheson, Hodenpyl.

Fragaria vesca L. Strawberry. Jones Wood, C. S. H.

Geum chiloense Balb. Chloe Avens. Hodenpyl; var. "Mrs. Bradshaw," Bailey, Matheson, DeForest, Hodenpyl.

Gillenia stipulata Trel. Indian Physic. Hodenpyl.

Gillenia trifoliata Moench. Bowmans Root. Hodenpyl.

Holodiscus discolor Maxim. Rock spirea. Hodenpyl.

Kerria japonica DC. Kerria. Matheson, DeForest, Laboratory grounds, C. S. H., Hicks, Bailey, Hodenpyl, Havemeyer, Pratt; var. *florepleno* (Double *Kerria*), Matheson.

Malus angustifolia Michx. (*Pyrus angustifolia* Ait.) Southern Crab. Hodenpyl, Bailey.

Malus (*Pyris*) *Arnoldiana* Bailey. Bailey, Hodenpyl, Hicks, Havemeyer.

Malus (*Pyrus*) *atrosanguinea* Spaeth. Bailey, Matheson, Hodenpyl, Havemeyer.

Malus baccata Borkh. (*Pyrus baccata* L.) Siberian Crab. Tiffany, Hodenpyl, Bailey.

Malus (*Pyrus*) *coronaria* Mill. (*Pyrus coronaria* L.) Wild Sweet Crab. Hodenpyl.

Malus (*Pyrus*) *floribunda* Nichols. Japanese Flowering Crab. Bailey and Hicks.

Malus (*Pyrus*) *Halliana* Koehne. (*Pyrus Halliana* Voss) Halls Crab. Bailey, Matheson, Hicks, Havemeyer. Var. *Parkmani* Hort. Matheson, Bailey, DeForest, Hicks.

Malus (*Pyrus*) *ioensis* Bailey. (*Pyrus ioensis* Bailey) Prairie Crab. Bailey, Havemeyer. Var. *plena* Hort., Bailey, Matheson, Hodenpyl, Hicks.

Malus (*Pyrus*) *okaido* Hort. Hodenpyl.

Malus (*Pyrus*) *Kowa Kamii* Hort. Hodenpyl.

Malus (*Pyrus*) *Niedzwetzkyana* Bailey. (*Pyrus Malus*. var. *Niedzwetzkyana*, Aschers & Graehn.) Redvein Crab, Hicks, Havemeyer.

Malus (*Pyrus*) *Prattii* Hort. Hodenpyl.

Malus (*Pyrus*) *prunifolia* Willd. Var. *Rinki* Bailey. Chinese Apple. Bailey.

Malus (*Pyrus*) *robusta* Hort. Cherry Crab. Hodenpyl.

Malus (*Pyrus*) *Sargenti* Rehd. (*Pyrus Sargenti* Bean) Sargent Crab. ailey, Hodenpyl, Havemeyer.

Malus (*Pyrus*) *Scheideckeri* Zabel. (*Pyrus pulcherrima*, var. *scheideckeri* Bailey.) Scheidecker Crab. Bailey, Hicks, Hodenpyl, Havemeyer.

Malus (*Pyrus*) *Sieboldi* Rehd. (*Pyrus Sieboldi* Regel) Toringo Crab. Hodenpyl.

Malus (*Pyrus*) *spectabilis* Borkh. (*Pyrus spectabilis* Ait.)

Chinese Flowering Crab. Bailey, Hodenpyl, Hicks, Havemeyer.

Malrus (*Pyrus*) *sylvestris* Mill. (*Pyrus Malus* L.) Apple, Willys, Tiffany.

Malus (*Pyrus*) *theifera* Bailey. Tea Crab. Bailey, Hodenpyl.

Malus (*Pyrus*) *toringoides* Hughes. (*Pyrus toringoides* Osborn) Cutleaf Crab. Havemeyer.

Malus (*Pyrus*) *Zumi* Rehd. (*Pyrus Zumi* Mats.) Zumi Crab. Bailey, Hicks.

Neillia sinensis Oliv. Tube Neillia. Bailey, Hodenpyl.

Neviusia alabamensis Gray. Snow wreath. Bailey.

Photinia villosa DC. Bailey, Matheson, DeForest, Hodenpyl, Hicks.

Physocarpus capitatus Kuntze. Hodenpyl.

Physocarpus opulifolius Maxim. Common Ninebark. Bailey, Hodenpyl, DeForest.

Potentilla fruticosa L. Shrubby Cinquefoil. Havemeyer, Bailey. Var: *Veitchi* Bean. (Veitch Cinquefoil) Bailey, Hodenpyl, Hicks.

Prinsepia sinensis Olwer. Cherry Prinsepia. Hodenpyl.

Rhodotypos kerrioides Sieb. & Zucc. Jet Bead. DeForest, Hodenpyl, Hicks, Havemeyer.

Prunus Armeniaca L. Apricot, Hodenpyl.

Prunus avium L. Sweet Cherry. Hodenpyl.

Prunus cerasifera Ehrb. Myrobalan Plum. Hodenpyl.

Prunus Cerasus Linn. Sour Cherry. Tiffany, Willys, Hodenpyl.

Prunus glandulosa Thunb. Almond. Double, Pinkflowering variety. Bailey.

Prunus incisa Thunb. var. *serrata* Hort. Bristleleaf Mame Cherry. Hodenpyl.

Prunus japonica Thunb. Dwarf Flowering Cherry. Hicks, Havemeyer.

Prunus Kanzan Hort. Hodenpyl.

Prunus Lannesiana Wils. Hitoye Cherry . Hodenpyl; var. *ariaka* Ariake, Tiffany, Hodenpyl; var. *hatazakuri* Hodenpyl;

var. *ojochin* Hodenpyl, Hort.; var. *Mikuramakaisi* Hodenpyl; var. *sirotae* Hodenpyl; var. *wasinwawa* Hodenpyl.

Prunus maacki Rupr. Amur Cherry. Bailey.

Prunus maritima Wangh. Beach Plum. Hicks, Havemeyer.

Prunus Maximowiczi Rupr. Miyama Cherry. Bailey.

Prunus Mume Sieb. & Zucc. Japanese Apricot. Bailey, Hodenpyl.

Prunus nigra Ait. (*P. Americana* Marsh. var. *nigra* Waugh.) Canada Plum. Havemeyer.

Prunus okuhuyake Hort. Hodenpyl.

Prunus pennsylvanica L. f. Pin Cherry. Bailey.

Prunus pilosiuscula Koehne var. *media* Hort. Hodenpyl.

Prunus Pseudocerasus Lindl. Havemeyer; var. *serrulata* Hort. (?) Oriental Cherry, Hodenpyl, Hicks, Havemeyer; var. *serrulata sachalinensis* Yama Cherry, Hodenpyl, Havemeyer; var. *s. s. fugenzo*, Hodenpyl; var. *Ichiyo*, Hodenpyl; var. *alba-rosa*, Hodenpyl.

Prunus serotina Ehrh. Wild Black Cherry. Bailey, Hicks, Willys.

Prunus shatsuk Hort. Hodenpyl.

Prunus Sieboldi Wittm. Siebold Cherry. Havemeyer.

Prunus spinosa domestica Hort. Hodenpyl.

Prunus subhirtella Miq. Higan Cherry. Bailey, Hodenpyl; var. *pendula*, Hodenpyl.

Prunus tomentosa Thunb. Hicks, Hodenpyl, Bailey.

Prunus triloba Lindl. Flowering Almond. Hodenpyl, Matheson, DeForest, Bailey, Hicks, Havemeyer.

Prunus virginiana L. Choke Cherry. Huntington Road C. S. H.

Prunus yedoensis Mats. Yoshino Cherry. Hodenpyl.

Prunus horticultural varieties:

Ariake (*P. lannesiana ariaka* Hort.), Tiffany, Hodenpyl.

Fugenzo (*P. serrulata sachalinensis fugenzo* Hort.), Hodenpyl.

Hata-zakura (*P. lannesiana hatazakura* Hort.), Hodenpyl.

Ichiyo. Hodenpyl.

Mikurumagaeshi (*P. lannesiana mikurumakaisi* Hort.) Hodenpyl.
Ojochin (*P. lannesiana ojochin* Hort.) Hodenpyl.
Shidare. Higan (*P. subjirtella pendula* Hort.) Hodenpyl.
Shirofugen (*P. serrulata sachalinensis albo-rosa* Hort.) Hodenpyl.
"Shirotae" (*P. lannesiana sirotae* Hort.) Hodenpyl.
"Washinowa" (*P. lannesiana wasinowo* Hort.) Hodenpyl.
"Yoshino Cherry" (*P. yedoensis* Hort.) Hodenpyl.

Pyracantha angustifolia Schneid. Narrowleaf Firethorn. Bailey.

Pyracantha coccinea Roem. Bailey, Hodenpyl. Var: *Lalandi* Dipp. Laland Firethorn. Bailey, Hodenpyl, Matheson, DeForest, Havemeyer.

Pyracantha crenulata Roem. Nepal Firethorn. Bailey.

Pyracantha linifolia Hort. Hodenpyl.

Pyrus communis L. Pear. Hodenpyl.

Pyrus serotina Rehd. Late Pear. Hodenpyl.

Rosa acicularis Lindl. Prickly Rose. Hodenpyl.

Rosa arkansana Porter. Arkansas Rose. Hodenpyl.

Rosa banksiae R. Br. Banksian Rose. Hodenpyl.

Rosa bella Hort. Solitary Rose. Hodenpyl.

Rosa blanda Ait (*R. virginiana Mill.*) Meadow Rose. Hicks. Var. *Willmottiae* Baker, Wilmot Rosa, Hodenpyl.

Rosa baicalensis Hort. Hodenpyl.

Rosa canina L. Dog Rose. C. S. H. vicinity.

Rosa centifolia L. Cabbage Rose. Hodenpyl.

Rosa coriifolia Hort. Leatherleaf Rose. Hodenpyl.

Rosa ecae Hort. Eca Rose. Hodenpyl, Bailey.

Rosa foetida Herrm. Austrian Brier Rose. Hodenpyl, Bailey.

Rosa gayana Hort. Hodenpyl.

Rosa helenae Hort. Helen Rose. Hodenpyl.

Rosa Hugonis Hemsl. Hugo Rose. Havemeyer, Kahn, Bailey, Hicks, Matheson, DeForest, Hodenpyl.

Rosa humilis Marsh (*carolina* L.) Pasture Rosa. Havemeyer.

Rosa Johanensis Hort. Hodenpyl.

Rosa Iheritierana Hort. Boursault Rose. Hodenpyl.
Rosa lucida Ehrh. Virginia Rose. Hodenpyl, Hicks.
Rosa Macouni Hort. Macoun Rosa. Hodenpyl.
Rosa maximowicziana var. *jacki* Hort. Hodenpyl.
Rosa mirifico Hort. Hodenpyl.
Rosa moyesi Hort. DeForest.
Rosa multibracteata Hort. Hodenpyl.
Rosa multiflora Thunb. Japanese Rose. Tiffany, Hodenpyl, Kahn; var. *cathayensis* Bailey. (Cathay Rose), Hodenpyl.
Rosa nitida Willd. Bristly Rose. Hodenpyl, Hicks.
Rosa omeiensis Rolfe. Mount Omei Rose. Hodenpyl; var. *pteracantha*, Country Life Press.
Rosa palustris Marsh (?) Swamp Rose. Hodenpyl.
Rosa Persica Michx. Persian Rose. DeForest.
Rosa pisocarpa Gray (?). Hodenpyl.
Rosa rudinuscula Hort. Hodenpyl.
Rosa pyrifera Hort. Hodenpyl.
Rosa roxburghi normalis Hort. Single Roxburgh Rose (*R. microphylla* Roxb.) Hodenpyl.
Rosa rubens Hort. Hodenpyl.
Rosa rubiginosa L. Sweet Brier. Matheson, Hodenpyl.
Rosa rugosa Thunb. Rugosa Rose. Tiffany, Willys, Huntington, Matheson, DeForest, Hodenpyl, Havemeyer; var. *repens* Hort.; *alba* Hort. Hodenpyl.
Rosa salictorum Hort. Hodenpyl.
Rosa sertata Hort. Garland Rose. Hodenpyl.
Rosa setigera Michx. Prairie Rose. Tiffany, Matheson, DeForest, Hodenpyl, Hicks, Dana Island.
Rosa spinosissima L. Scotch Rose. DeForest, Hodenpyl, Havemeyer, Country Life Press; var. *altaica* Hort. DeForest, Hodenpyl; var. *myriacantha* W. D. Koch. Hodenpyl.
Rosa stellata Wooton. New Mexican Rose. Hodenpyl.
Rosa Watsoniana Crep. Watson Rose. Hodenpyl.
Rosa wichuraiana Crep. Wichurian Rose. Matheson, Hodenpyl, Hicks, DeForest.

Rosa xanthina Lindl. Korean Rose. DeForest, Hodenpyl, Havemeyer.

Rosa horticultural varieties:

Aglaia Mult. (P. Lamb. 1896) Yellow Rambler. Hodenpyl.
Alfred Colomb H. P. (Lach. 1865) DeForest, Hodenpyl.
American Beauty Cl. DeForest, Matheson.
American Pillar H. W. (Van F. 1902) Matheson.
Arnold H. Rug. (Dawson 1893) Hodenpyl.
Avoca HT (A. Dicks, 1907), Matheson.
Baby Rambler, Red., DeForest.
Baby Tausendschon Tiffany, Matheson, DeForest.
Baltimore Belle. Set. (Feast 1843), Hodenpyl.
Baroness Rothschild, H.P. (Pernet 1867), Matheson, DeForest, Hodenpyl.
Bennet's seedling. Matheson.
Betty, H. T. (A. Dicks 1905) Matheson, DeForest.
Blue Rambler. Hodenpyl.
Captain Christy HT. (Lach. 1873) DeForest, Hodenpyl.
Captain Hayward HT. (Ben. 1893) Tiffany, DeForest.
Carolina Testout. DeForest, Hodenpyl.
Catherine Zeimer, DeForest.
Chatenay. DeForest.
Chateau de Clos Vougeot. HT. (Per D. 1908) DeForest.
Christine Wright HW. (Hoopes 1909) DeForest.
Clio HR. (W. Paul 1894) Matheson.
Columbia HT. (E. G. Hill 1917) Willys, Kahn.
Countess of Darby HT. (A. Dicks 1905) Hodenpyl.
Crimson Rambler. Mult. (Turn 1893) Matheson, DeForest, Hodenpyl, Tiffany.
Daily Mail. DeForest.
Dawson Mult (Dawson 1889) Hodenpyl.
Dean Hole HT (A. Dicks, 1907) Hodenpyl.
Dacota (Padres.) Matheson.
Dorothy Page-Roberts HT (A. Dicks, 1907) Matheson, Hodenpyl.
Dorothy Perkins, H. W. (J. & P. 1902) Willys, Matheson, Kahn, DeForest, Hodenpyl, Tiffany.
Dorothy Perkins, Baby, Matheson.
Dorothy Perkins, White, Matheson.
Double White Killarny HT (Bud. 1913, Tot. 1914) Matheson.
Dr. W. Van Fleet, H. W. (Van F. 1910) Tiffany, Matheson, DeForest, Hodenpyl.
Duchess of Wellington, HT (A. Dicks, 1909) Matheson, Willys.
Earl of Dufferin HP (A. Dicks 1887) Hodenpyl.

Earl of Warwick HT (W. Paul 1904) DeForest.
Echo P. Pol. (P. Lamb 1914) Kahn.
Eclair HP (Lach 1883) DeForest.
Eglantine. Matheson.
Elli Hartmann, HT (Welt 1913) DeForest.
Emily Gray, HW (Williams 1918) DeForest.
Etoile de France HT (Per D. 1904) Hodenpyl.
Euphrosyne. Mult. (P. Lamb. 1896) Matheson.
Evangeline H. W. (Wallsh 1906) DeForest.
Evergreen Gem. HW (Manda 1889) Hodenpyl.
Farquhar, HW. (Dawson 1903) Hodenpyl.
Fisher Holmes HP (E. Verd. 1865). Hodenpyl.
Florence Pemberton HT (A. Dicks 1903) Matheson.
Francois Juranville HW (Bar 1906) DeForest.
Frau Karl Druschki, HP (P. Lamb. 1900) Tiffany, Matheson, DeForest, Hodenpyl.
F. W. Flight. Matheson.
Gardenia HW (Manda 1899) Matheson, Hodenpyl.
General Jacqueminot HP (Roussel 1852) Matheson, Hodenpyl.
General MacArthur (E. G. Hill 1904) Matheson, DeFoerst.
George Dickson HP (A. Dicks 1913) Matheson.
Golden Ophelia HT (B. R. Cant 1919) DeForest.
Greville, Mult, Hodenpyl.
Harrison's Yellow AB (Harrison 1830) Hodenpyl.
Harry Kirk T. (A. Dicks 1907) DeForest, Hodenpyl.
Hiawatha, H. W. (Walsh 1904) Willys, Matheson, DeForest, Hodenpyl.
Hon. Edith Gifford T. (Gio.; Fils. 1882) Hodenpyl.
Irish Afterglow HT (A. Dicks 1918) DeForest.
Irish Elegance, HT (A. Dicks, 1905) DeForest.
Irish Engineer, HT (A. Dicks, 1904) DeForest.
Irish Fireflame HT (A. Dicks 1913) DeForest.
Jonkheer J. L. Mock, H. T. (Leend, 1909) DeForest.
Kaiserin Auguste Viktoria HT (Lambert & Reiter 1891) Matheson, DeForest, Hodenpyl.
Katherine Zeimet, D. Pol (P. Lamb. 1901) DeForest.
Killarney H. T. (A. Dicks 1898) DeForest, Diffany, Willys, Hodenpyl.
Killarney Brillant. H. T. (A. Dicks, 1914) DeForest.
LaFrance HT (Guil. Fils. 1867) Matheson, Hodenpyl.
Killarney Queen HT (Bud. 1912) DeForest.
Killarney White. DeForest.
La Tosa HT (Mme Schw. 1900) Matheson, DeForest.
Lady Alice Stanley HT (Meg. 1909) Hodenpyl.

Lady Ashtown, HT (A. Dicks, 1905) Matheson, DeForest, Hodenpyl.
Lady Duncan HW (Dawson 1900) Hodenpyl.
Lady Hillingdon, T. (L. & S. 1910) Matheson, DeForest.
Lady Penzance H. & S.B. (Penz. 1894) Kahn.
Lady Ursula HT (Per D. 1907) Matheson, DeForest, Hodenpyl.
Laurent Carle HT (Per. D. 1907) DeForest, Hodenpyl, Matheson.
Lyon, R. Per (Per. D. 1907) DeForest, Hodenpyl.
Marechal Niel Nois. (Pradel 1864) Matheson.
Marie Paric T. Pol. (Alegatiere 1888) Hodenply.
Marquise de Sinety, HT (Ter. D. 1906) DeForest.
Mary, Countess of Ilchester, HT (A. Dicks 1909) Matheson, Hodenpyl.
Mary Wallace H. W. (Van F. 1921) DeForest.
Max Graf. H. Rug. (Bowditch 1919) Hodenpyl.
Miss Cynthea Fords HT (H. Dicks 1909) Matheson, DeForest.
Austrian Copper A. B. (Ger. 1596) Hodenpyl.
Areateur Bleriot H. W. (Fauq. 1910) Matheson, DeForest.
Miss Lolita Armour. Per (H. & S. 1919) DeForest.
Mme. Abel Chatenay, HT (Per. D. 1894) DeForest.
Mme. Butterfly, HT (E. G. Hill 1918) DeForest.
Mme. Caroline Testout HT (Per. D. 1890) Hodenpyl.
Mme. Edouard Herriot. Per. (Per. D. 1913) DeForest.
Mme. Joseph Combet. HT (Bonnaire 1894) Hodenpyl.
Mme. Jules Grolez. HT (P. Guil. 1897) DeForest.
Mme. Leon Pain. HT (P. Guil, 1904) Mathesan, DeForest.
Mme. Melanie Soupert, HT (Per. D. 1905) DeForest, Hodenpyl.
Mme. Ravary HT (Per. D. 1899) DeForest.
Mme. Segond Weber HT (S. & N. 1908) DeForest.
Mollly Sharman-Crawford, T. (A. Dicks, 1908) DeForest.
Mrs. Aaron Ward, H. T. (Per D. 1907) Matheson, DeForest.
Mrs. John Laing HP (Ben. 1887) Matheson, DeForest, Tiffany.
Mrs. R. G. Sharman, Crawford, HP (A. Dicks 1894) Tiffany, Matheson, Kahn, Hodenpyl.
Mrs. Wakefield Christie-Miller HT (M. & G. 1909) Matheson DeForest.
My Maryland HT (J. Cook 1908) DeForest
Ophelia, HT (W. Paul 1912) Tiffany, Willys, Matheson, DeForest.
Paul Newron HP (Levet 1869) Matheson, DeForest.
Paul's Scarlet Climber, H. W. (W. Paul 1916) Matheson.
Persian Yellow AB (Willock 1837) Kahn, Hodenpyl.
Pilgrim, H. T. (Mont. 1920) Kahn.
Prince Camille de Rohan HP (E. Verd. 1861) Hodenpyl.
Prince de Bulgarie HT (Per. D. 1902 DeForest, Hodenpyl.
Provence Rose. Hodenpyl.

Queen of Fragrance, HT (W. Paul 1915) DeForest.
Queen of the Prairies Sct. (Feast 1843) Hodenpyl.
Radiance HT (J. Cook 1908) Matheson, DeForest.
Red Chatenay, HT. DeForest.
Red Radiance HT (A. N. Pier, 1916) Matheson.
Red Rugosa. Matheson.
Rev. F. Page-Roberts HT (B. R. Cant 1921) DeForest.
Rubin, Mult. (Schmidt 1899) Hodenpyl.
Rugosa alba. Matheson.
Seven Sisters. Greville, Hodenpyl.
Silver Moon, H. W. (Van F. 1910) Hodenpyl, Matheson, DeForest.
South Orange Perfection, HW (Manda 1899) Hodenpyl.
Souv. de Claudius Pernet. Par (Per. D. 1920) Kahn, Matheson, DeForest.
Souv. de Georges Parnet. Per (Per. D. 1921) Matheson.
Sunburst HT (Per. D. 1912) Kahn, DeForest.
Tausendschon. Mult. (Schmidt 1906) Matheson, DeForest, Hodenpyl.
Ulrich Brunner HP (Levet 1881) Tiffany, Matheson, Hodenpyl.
Universal Favorite HW. (Manda 1899) Hodenpyl.
Veilchen blau. Mult. (Schmidt 1908) Hodenpyl.
Viscountess Folkestone HT. (Ben. 1886) Matheson, DeForest.
White Killarney HT. (Wahan Rose Conservatories 1909) Matheson, DeForest.
William C. Egan. HW (Dawson 1900) Hodenpyl.
Willowmere. Per. (Per. D. 1913) DeForest.
Yvone Rabier. D. Pol. (Tur. 1910) Matheson, DeForest.

Rubus flagellaris Willd. Dewberry C. S. H., Sandpit Road.
Rubus laciniatus Willd. Cutleaf Blackberry. Hodenpyl, Bailey.
Var. *leucodermis* Card. Whitebark Raspberry. Bailey.
Rubus occidentalis L. Black Raspberry. C. S. H. vicinity.
Rubus odoratus L. Flowering Raspberry. Hodenpyl, Matheson. Laboratory grounds, C. S. H.
Rubus phoenicolasius Maxim. Wineberry. Laboratory grounds, C. S. H.
Rubus spectabilis Pursh. Salmonberry. Havemeyer.
Rubus thyrsanthus Focke. Himalaya Berry. Bailey.
Rubus thyrsoideus Hodenpyl.
Rubus ulmifolius Schott. Elmleaf Blackberry. Hodenpyl.
Rubus xanthocarpus Bur. & Franch. Havemeyer.
Sorbaria Aitchisoni Hemsl. Kashmir False Spirea. Bailey, Hodenpyl, Hicks, Country Life Press.

Sorbaria arborea Schneid. Tree Spirea. Hodenpyl.
Sorbaria Lindleyana Maxim. Lindley False Spirea. Bailey.
Sorbaria sorbifolia A. Br. Ural False Spirea. Bailey, Sandspit Road, C. S. H. Matheson, DeForest, Hodenpyl, Havemeyer.
Sorbus americana Marsh. Mountain Ash. Hicks, Hodenpyl, Matheson, Tiffany, DeForest, Havemeyer.
Sorbus Aucuparia L. Service Tree. European Mountain Ash. Matheson, Hodenpyl, Bailey.
Sorbus domestica L. Service Tree. Hodenpyl.
Stephanandra flexuosa Sieb. & Zucc. (*Incisa*, Zabal) Cutleaf Stephanandra. Bailey, Matheson, Hodenpyl, Hicks, Davenport garden, C. S. H., Havemeyer.
Stephanandra Tanakae Franch & Sav. Yeddo Stephanandra. Bailey.
Spiraea alba Dur. Meadow Spirea. Matheson, Bailey.
Spiraea albiflora Miq. Matheson, Hodenpyl, Havemeyer.
Spiraea arguta Zabel. Garland Spirea. Hodenpyl, Hicks.
Spiraea Billiardii Hort. Hicks, Bailey, Havemeyer.
Spiraea Bumalda Bur. Matheson, Hicks, Bailey.
Spiraea cantoniensis Louv. var. *lanceata* Hort. Matheson.
Spiraea chamaedryfolia L. var. *ulmifolia* Max. Elmleaf Spirea. Hodenpyl.
Spiraea Chinensis Max. Chinese spirea. Hodenpyl.
Spiraea crenata L. Snow Spirea. Hodenpyl.
Spiraea gloria Hort. Hodenpyl.
Spiraea henryi Hemsl. Henry Spirea. Bailey, Hodenpyl.
Spiraea inflexa C. Koch. Hodenpyl.
Spiraea japonica L. Japanese Spirea. Hicks, Hodenpyl, Pratt.
Spiraea latifolia Borkh. Pink Meadow Spirea. Bailey, Tiffany, Hodenpyl, Hicks.
Spiraea lucida Dougl. Hodenpyl. Var. *plena* Hort. Matheson.
Spiraea prunifolia Sieb. & Zucc. Bridal Wreath. Bailey, Matheson, Havemeyer.
Spiraea Reevesiana Lindl. (*S. Cantoniensis* Lour.) Reeves Spirea. DeForest, Hodenpyl.
Spiraea Rosthorni Pritz. Rosthorn Spirea. Hodenpyl.

Spiraea salicifolia L. Willowleaf Spirea. Hodenpyl.
Spiraea Sargentiana Hort. Hodenpyl.
Spiraea sylvestris Hort. Hodenpyl.
Spiraea Thunbergii Sieb. Thunberg Spirea. Tiffany, Matheson, DeForest, Hodenpyl, Bailey, Hicks, Havemeyer, Pratt.
Spiraea trichocarpa Hort. Hodenpyl.
Spiraea tomentosa L. Hardhack. Hodenpyl.
Spiraea Vanhouttei Zabel. Van Houtti Spirea. Matheson, Hicks, Tiffany, DeForest, Hodenpyl, Havemeyer.
Spiraea Veitchi Hemsl. Veitch Spirea. Hodenpyl, Bailey.
Spiraea—Horticultural varieties:

Anthony Waterer Spirea (*Spiraea Bumalda* Burr.) Tiffany, Matheson, Hodenpyl, Hicks, Bailey, Willys.
Billiard Spiraea (*S. Billiardi Heringc.*) Hicks, Bailey, Havemeyer.
Double Bridal Wreath (*Spiraea prunifolia* var. *plena* Hort.) Matheson.
Double Reeves Spirea (S. Cantoniensis var. lanceata) Hort. Matheson.
Garland Spirea (*S. arguta* Hort.) Hodenpyl, Hicks.

LEGUMINOSAE.

Albizzia Lebbek Benth. Lebbek Tree. Havemeyer.
Amorpha canescens Nutt. Lead Plant. Hodenpyl, Bailey, Hicks.
Amorpha fruticosa L. Bastard Indigo. Matheson. Laboratory grounds, C. S. H., Bailey, Hicks; var. *glabra* Desf. Mountain Indigo. Bailey.
Amorpha microphylla Pursh. Dwarf Indigo. Hodenpyl.
Apios tuberosa Moench. Potato Bean. Hodenpyl, Matheson.
Baptisia australis R. Br. Blue Wild Indigo. Matheson, DeForest, Hicks.
Baptisia tinctoria R. Br. False Indigo. Hodenpyl, Hempstead Plain, Matheson.
Calliandra Tweedii Benth. Havemeyer.
Caragana arborescens Lam. Siberian Pea-Shrub. Matheson, DeForest, Bailey, Hicks, Havemeyer.
Cassia marilandica L. Wild Senna. Matheson.

Cercis canadensis L. American Red bud. Tiffany, Matheson, DeForest, Hodenpyl, Bailey, Hicks, Havemeyer.
Cercis chinensis Bunga. Chinese Red bud. Hodenpyl, Hicks.
Cercis Siliquastrum L. Judas Tree. Willys.
Chorizema ilicifolium Labill. Bailey.
Cladastris amurensis Koch. Amur Maackia. Hicks, Bailey.
Colutea arborescens L. Common Bladder Senna. Bailey, Matheson, Hodenpyl, Hicks, Havemeyer.
Colutea orientalis Mill. Oriental Bladder Senna. Bailey, Hodenpyl.
Coronilla glauca L. Honey Coronilla. Havemeyer.
Cladrastis lutea Koch. Yellow Wood. Bailey, Matheson, Hicks, Dana Island.
Cytisus canariensis Kuntze. Canary Bridal Veil. Bailey, Willys.
Cytisus leucanthus Waldst. & Kit. Pale Broom. Hodenpyl. Var. *schipkaensis* Dipp. Bulgarian Bridal Veil. Bailey.
Cytisus nigricans L. Spike Broom. Hodenpyl.
Cytisus racemosus Nichols. Easter Broom. Havemeyer.
Cytisus scoparius Link. Scotch Bridal Veil. Bailey, Hodenpyl, Hicks, Havemeyer. Var. *andreanus* Dipp. (Paradise Broom), Matheson.
Desmodium canescens (L) DC. Hoary Tick Clover. Matheson.
Dolichos lablab L. var. *giganteus* Hort. Giant Hyacinth Bean. Tiffany.
Galega officinalis L. Goat's Rue. Havemeyer, Matheson.
Genista Aetnensis DC. Aetna Broom. Tiffany.
Genista pilosa L. Silkyleaf Broom. Hodenpyl.
Genista tinctoria L. Dyers Greenweed. Havemeyer; var. *virgata* Hort. Tall Woadwaxen, Hodenpyl.
Gleditsia triacanthos L. Honey Locust. Bailey, Tiffany, Matheson, DeForest, Hodenpyl, Hicks; var. *inermis* DC. (Thornless Honey Locust), Hicks.
Gymnocladus dioica (L.) Koch. Kentucky Coffee Tree. DeForest, Hodenpyl, Hicks.
Halimodendron argenteum Fisch. Salt Tree. Hodenpyl.
Indigofera amblyantha Craib. Pink Indigo. Hodenpyl, Hicks, Havemeyer.

Indigofera decora Lindl. Chinese Indigo. Hodenpyl. Var: *alba* Hort., *purpurea* Hort., Havemeyer.
Indigofera Gerardiana Grah. Himalayan Indigo. Bailey.
Indigofera Kirilowi Max. Kirilow Indigo. Bailey, Hodenpyl.
Indigofera potanini Hort. Potanin Indigo. Bailey, Hodenpyl, Havemeyer.
Indigofera purpurea Hort. Hodenpyl.
Indigofera tinctoria L. Indigo. Bailey.
Laburnum Adami Kirchn. Adam Laburnum. Bailey.
Laburnum alpinum Griseb. Scotch Laburnum. Bailey, Tiffany, DeForest, Hodenpyl.
Laburnum vulgare Griseb. (*L. anagyroides* Medic.) Goldenchain. Bailey, Matheson, Hicks, Havemeyer.
Laburnum Watereri Dipp. Waterer Laburnum. Bailey.
Lathyrus latifolius L. Perennial Pea. Havemeyer, Bailey, Tiffany, Matheson, Hodenpyl; var. *splendens* Hort. (Royal Perennial Pea), Hodenpyl; var. *albus* Hort. (White Perennial Pea), Hodenpyl.
Lathyrus odoratus L. Sweet Pea. Matheson.
Lespedeza bicolor Turcz. Shrub Bushclover. Bailey, Hicks.
Lespedeza formosa Koehne. Purple Bushclover. Bailey, Hodenpyl, Havemeyer; var. *albiflora* Hort. (*Lespedeza japonica* Bailey?), Dana Island.
Lespedeza praecox Hort. Hodenpyl.
Lespedeza striata Hook & Arn. Japan Clover. Havemeyer.
Lupinus albus L. White Lupine. Havemeyer.
Lupinus arboreus Sims. Tree Lupine. Bailey, DeForest.
Lupinus perennis L. Sun-Dial Lupine. Hodenpyl, Hicks.
Lupinus polyphyllus Lindl. Washington Lupine. Tiffany, Matheson, Kahn, DeForest, Hicks.
Maackia Faurei Hort. Hodenpyl.
Medicago sativa L. Alfalfa. C. S. H.
Melilotus indica All. Laboratory grounds, C. S. H.
Mimosa pudica L. Sensitive Plant. Havemeyer.
Robinia hispida L. Rose Acacia. Havemeyer, Pratt.
Robinia Pseudoacacia L. Yellow Locust. Tiffany, Willys, Bailey, Matheson, DeForest, Hodenpyl, Pratt.

Sophora japonica L. Chinese Pagoda tree. Matheson, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt.

Sophora viciifolia Hance. Vetchleaf Sophora. Hodenpyl.

Swainsonia galegifolia R. Br. Goats Rue, Senna Pea. Havemeyer.

Thermopsis Caroliniana M. A. Curtis. Carolina Thermopsis. Bailey, Kahn, DeForest.

Thermopsis fabacea DC. Bean Thermopsis. Hodenpyl.

Thermopsis rhombifolia Richards. Hodenpyl.

Trifolium hybridum L. Alsike Clover. Laboratory grounds, C. S. H.

Trifolium pratense L. Red Clover. Laboratory grounds, C. S. H.

Vicia Cracca L. Laboratory grounds, C. S. H.

Wisteria frutescens Poir. American Wisteria. Hodenpyl, Hicks. Var. "*magnifica*" Herincq, Hicks.

Wisteria multijuga Van Houtte (*W. floribunda* DC.) Long-cluster Wisteria. Tiffany, Matheson, Kahn, DeForest, Hicks.

Wisteria sinensis Sweet. Chinese Wisteria. DeForest, Hicks, Davenport, Bailey, Matheson, Havemeyer. Var. *albiflora* Le Maire. White Chinese Wisteria, DeForest.

Wisteria speciosa Nutt. Var. *magnifica* Hort. Yellow Eye Wisteria. Hodenpyl.

Wisteria venusta Rehd. & Wils. Silky Wisteria. Tiffany, DeForest, Hicks, Bailey.

ORDER XXIII. GERANIALES.

GERANIACEAE.

Geranium maculatum L. Wild Geranium. Matheson.

Geranium sanguineum L. Bloodred Cranesbill. DeForest, Hodenpyl.

Pelargonium domesticum. Bailey. Lady Washington Geranium. Kahn.

Pelargonium graveolens L'Her. Rose Geranium. Matheson, Country Life Press.

Pelargonium peltatum Ait. Ivy Geranium. Fish Hatchery, C. S. H.

OXALIDACEAE.

Oxalis corniculata L. Wood-Sorrel. Matheson.

Oxalis violacea. Violet Woodsorrel. Tiffany, Hodenpyl.

TROPAEOLACEAE.

Tropaeolum majus L. var. *nanum* Hort. Tom Thumb Nasturtium. Tiffany.

LINACEAE.

Linum flavum L. Golden Flax. Matheson, DeForest.

Linum grandiflorum Desf. Flowering Flax. Havemeyer.

Linum perenne L. Perennial Flax. Bailey, Tiffany, Matheson, Kahn, DeForest, Hodenpyl, Hicks, Havemeyer, Country Life Press.

RUTACEAE.

Dictamnus albus L. Gas Plant. Bailey, Tiffany, Matheson, DeForest, Hicks, Country Life Press; var. *rubra* Hort. (Purple Gas Plant), Bailey, Matheson, DeForest.

Phellodendron chinense Schneid. Chinese Corktree. Matheson, Hodenpyl.

Phellodendron japonicum Maxim. Havemeyer.

Poncirus trifoliata Raf. Trifoliate Orange. Davenport.

Ptelea trifoliata L. Common Hoptree. Hicks, C. S. H. Village.

Ruta Graveolens L. Common Rue. Hicks.

Skimmia japonica Thunb. Japanese Skimmia. DeForest, Havemeyer.

Xanthoxylum americanum Mill. Common Prickly Ash. Hodenpyl, Bailey.

Xanthoxylum piperitum DC. Japanese Prickly Ash. Hodenpyl.

SIMARUBACEAE.

Ailanthus altissima Swingle. Tree-of-Heaven. Pratt.

Ailanthus Glandulosa Desf. Chinese Tree of Heaven. Matheson, Willys, Bailey, Hicks.

MELIACEAE.

Cedrela sinensis Juss. Chinese Cedrela. Bailey.

POLYGALACEAE.

Polygala paucifolia Willd. Fringed Polygala. Hodenpyl.

EUPHORBIACEAE.

Daphniphyllum humile Hort. Hodenpyl.

Daphniphyllum macropodum Miq. Bailey.

Euphorbia corollata L. Flowering Spruge. Bailey, Tiffany, Matheson.

Euphorbia fulgens Karw. Scarlet plume. Kahn.

Euphorbia marginata Pursh. Snow-on-the-Mountain. Tiffany.

Poinsettia pulcherrima Klotzsch & Garcke. Poinsettia. (*Euphorbia pulcherrima* Willd.), Tiffany, Matheson.

(To be continued.)

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A LIST OF PLANTS GROWING UNDER CULTIVATION IN THE VICINITY OF COLD SPRING HARBOR, N. Y.

N. M. AND C. R. GRIER

(Continued from Last Issue.)

ORDER XXIV. SAPINDALES.

BUXACEAE.

Buxus balearica Willd. Spanish Box. Hodenpyl.

Buxus japonica Muell. Arg. (*Microphylla* var. *japonica* Rehd. & Wils.) Japanese Box. Havemeyer, Bailey.

Buxus microphylla Sieb. and Zucc. Country Life Press.

Buxus sempervirens L. Common Box. Bailey, Hodenpyl, Blackford Hall, C. S. H., Matheson, pahn, Willys, Tiffany, Havemeyer, Pratt. Var. *Handsworthi* Hort. Handsworth Box, Bailey; var. *rotundifolia* Hort. Roundleaf Box, DeForest; var. *suffruticosa* L. True dwarf Box, DeForest.

Pachysandra procumbens Michx. DeForest, Hodenpyl.

Pachysandra terminalis Sieb. & Zucc. Hodenpyl, DeForest, Willys, Hicks, Havemeyer, Pratt.

EMPETRACEAE.

Corema Conradii Torr. Broom Crowberry. Hodenpyl.

CORIARIACEAE.

Coriaria terminalis Hemsl. Sikkim Coriaria. Bailey.

ANACARDIACEAE.

Cotinus Coggygria Scop. Smoke-Tree. C. S. H. village. DeForest, Hodenpyl, Hicks, Bailey.

Rhus canadensis Marsh. Fragrant Sumac. Bailey, Hodenpyl.

Rhus copallina L. Shining Sumac. Bailey, Hodenpyl, Hicks.

Rhus glabra L. Smooth Sumac. Hodenpyl; var. *cismontana* Hort. (Yellow Sumac), Hodenpyl.
Rhus javanica L. Java Sumac. Hodenpyl, Bailey.
Rhus orientalis Hort. Hodenpyl.
Rhus typhina L. Staghorn Sumac. DeForest, Hodenpyl, C. S. H., Hicks.

AQUIFOLIACEAE.

Ilex Aquifolium L. English Holly. Matheson, DeForest, Havemeyer.
Ilex cornuta Lindl. Chinese Holly. Havemeyer.
Ilex crenata Thunb. Japanese Holly. Tiffany, Matheson, Havemeyer, DeForest, Hodenpyl, Hicks; var. *microphylla* Hort. Little Leaf Japanese Holly, Matheson.
Ilex decidua Walt. Possum Haw. Bailey.
Ilex glabra Gray. Inkberry. Matheson, Bailey, DeForest, Hodenpyl, Hicks, Havemeyer, Country Life Press.
Ilex geniculata Hort. Hodenpyl.
Ilex opaca Ait. American Holly. Matheson, Bailey, Tiffany, DeForest, Hodenpyl, Hicks, Havemeyer, Country Life Press.
Ilex verticillata Gray. Black Alder. Matheson, Bailey, Havemeyer, Hodenpyl, Hicks.
Nemopanthus mucronatus (L.) Trel. Mountain Holly. Hodenpyl.

CELASTRACEAE.

Celastrus angulatus Max. Hodenpyl.
Celastrus orbiculatus Thunb. Oriental Bittersweet. Hodenpyl, Hicks; var. *punctatus* Rehder. Christmas Bittersweet. Hodenpyl.
Celastrus paniculatus Willd. Hodenpyl, Havemeyer.
Celastrus scandens L. Waxwork. Bailey, Hodenpyl, DeForest, Matheson, Hicks, Havemeyer.
Euonymus alata Regel. Winged Euonymus. Bailey, Tiffany, Matheson, DeForest, Hodenpyl, Hicks, Havemeyer.
Euonymus americanus L. Brook Euonymus or Strawberry Bush. Bailey, Matheson.

Euonymus atropurpureus Jacq. Wahoo or Burning Bush. Bailey.
Euonymus Bungeana Maxim. Winterberry Euonymus. Bailey, Hicks.
Euonymus europaea L. Hodenpyl.
Euonymus japonica L. Evergreen Burning Bush. Hodenpyl, Bailey, Willys, Kahn.
Euonymus nana Bieb. Dwarf Burning Bush. Hodenpyl.
Euonymus obovata Nutt. Hicks Nursery. Hodenpyl.
Euonymus planipes Hort. Hodenpyl.
Euonymus radicans Sieb. Wintercreeper. Tiffany, Matheson, Hodenpyl, Hicks, Havemeyer; var. *acutus* Hort. (Sharp leaf W.), Hodenpyl, Hicks, Havemeyer; var. *kewensis* Hort. (Baby W.), Bailey, Matheson, DeForest, Hodenpyl, Havemeyer; var. *vegetus* Hort. (Big leaf W.), Matheson, DeForest, Hodenpyl, Hicks, Country Life Press, Hort. (*E. Sieboldianus*, Blume.)
Euonymus yedoensis Hort. Yeddo Euonymus. Bailey.
Euodia hupehensis Hort. Hodenpyl.
Pachistima Canbyi Gray. Canby Pachistima. DeForest, Hodenpyl, Hicks, Bailey.
Pachistima myrisinites Raf. Myrtle Pachistima. Hodenpyl.
Tripterygium Regilii Sprague and Ketchum. Hodenpyl.

STAPHYLEACEAE.

Staphylea Bumalda DC. Bumalda Bladdernut. Bailey, Havemeyer.
Staphylea colchia Stev. Colchis Bladdernut. Hodenpyl.
Staphylea trifolia L. Bladder Nut. C. S. H. vicinity.

ACERACEAE.

Acer campestre L. Hedge Maple. Bailey.
Acer crataegifolium S. and Z. Hodenpyl.
Acer Ginnala Maxim. Amur Maple. DeForest, Hodenpyl, Bailey, Hicks.
Acer japonicum Thunb. Full-Moon Maple. Pratt. Var. *Parsonsi* Veitch, Fernleaf Maple, DeForest, Hodenpyl.
Acer Negundo L. Box-Elder. Hodenpyl, Willys, Bailey.

Acer palmatum Thunb. Japanese Maple. Willys, Hodenpyl, Matheson, Bailey, Hicks, Tiffany. Var. *atropurpureum* Van Houte. Purple Leaved Japanese Maple, Willys, Hodenpyl, Matheson; var. *dissectum*, Koch. Japanese Cut-leaved Maple, Matheson; var. *reticulatum* Andre. Green Net Maple, Hodenpyl; var. *rubrum* Schwer. Red Japanese Maple, Matheson, DeForest.

Acer pennsylvanicum L. Striped Maple. Hodenpyl, Bailey.

Acer pictum Thunb. Painted Maple. Hodenpyl.

Acer platanoides L. Norway Maple. DeForest, Hodenpyl, Matheson, Bailey, Hicks, Pratt; var. *cucullatum* Nicholls, Crimped Norway Maple, Willys; var. *globosum* Hort., Globe Maple, Hicks; var. *Schwedleri* Koch, Schwedler Maple, Willys, Hicks.

Acer Pseudo-platanus L. Sycamore Maple. Hodenpyl, Matheson, Bailey, Tiffany, Hicks.

Acer Pseudo-Sieboldianum Hort. Hodenpyl.

Acer rubrum L. Red Maple. Matheson, Hodenpyl, Willys, Bailey, Hicks.

Acer saccharinum L. Silver Maple. Willys, Bailey, Hicks, Pratt.

Acer saccharum Marsh. Sugar Maple. Hodenpyl, Hicks.

Acer spicatum Lam. Mountain Maple. Hodenpyl.

Acer tataricum L. Tatarian Maple. Hodenpyl.

HIPPOCASTANACEAE.

Aesculus carnea Hayne. Havemeyer. Var. *Briotti* Nicholls. Ruby Horse Chestnut. Bailey.

Aesculus discolor var. *Mollis* Sarg. Scarlet Buckeye. DeForest, Hodenpyl, Bailey.

Aesculus georgiana Sarg. Georgia Buckeye. DeForest, Hodenpyl, Matheson.

Aesculuc glabra Willd. Ohio Buckeye. Bailey, Hicks.

Aesculus glaucescens Sarg. Hodenpyl.

Aesculus Hippocastanum L. Common Horse Chestnut. Matheson, Bailey, Hicks, Willys, Havemeyer, Pratt.

Aesculus octandra Marsh. Yellow Buckeye. Bailey.

Aesculus parviflora Walt. Buckeye. DeForest, Hicks, Matheson, Bailey, Country Life Press.
Aesculus Pavia L. Red Buckeye. Hodenpyl, Bailey.
Aesculus Pavia var. *atrosanguinea* Hort. Red Buckeye. Bailey, Willys.
Aesculus turbinata Blumc. Japanese Horse Chestnut. Hodenpyl, Bailey.

SAPINDACEAE.

Koelreuteria paniculata Laxm. Golden Rain-Tree. DeForest, Hodenpyl, Bailey, Hicks, Havemeyer, Country Life Press.
Paullinia thalictrifolia Juss. Meadow Rue Paullinia. Havemeyer.
Xanthoceras sorbifolia Bunge. Hodenpyl, Havemeyer.

BALSAMINACEAE.

Impatiens Balsamina L. Garden Balsam. Bailey.

ORDER XXV. RHAMNALES.

RHAMNACEAE.

Berchemia racemosa Sieb. and Zucc. Japanese Supplejack. Matheson.
Ceanothus americanus L. Jersey Tea. Bailey, Hodenpyl, DeForest.
Rhamnus Cathartica L. Common Buckthorn. Matheson, Hodenpyl, Hicks.
Rhamnus Frangula L. Glossy Buckthorn. Hodenpyl.
Rhamnus schneideri var. *mandschurica* Hort. Hodenpyl.

VITACEAE.

Ampleopsis aconitifolia Bunge. Hodenpyl, Bailey. Var: *dissecta* Koehne. Hodenpyl.
Ampleopsis amurensis Hort. (?) Amur Ampelopsis. Hodenpyl.
Ampelopsis brevipendunculata Koehne. Blackford Hall, C. S. H., Hodenpyl; var. *elegans* Koch. Bailey, Hodenpyl.
Ampelopsis cordata Michx. Heartleaf Ampelopsis. Hodenpyl.
Ampelopsis henryana Hort. Silver Vein Creeper. Bailey.
Ampelopsis quinquefolia Michx. (*Parthenocissus quinquefolia*

Planch) Virginia Creeper. Hodenpyl, Tiffany, Blackford Hall, C. S. H., Bailey, Matheson, Hicks, Willys; var. *Engelmanni* Hort. Bailey, Hodenpyl, Hicks.

Ampelopsis tricuspidata Sieb. & Zucc. (*Parthenocissus tricuspidata* Planch) Japanese or Boston Ivy. Hodenpyl, Tiffany, Blackford Hall, C. S. H., Hicks, Kahn, Matheson.

Vitis aestivalis Michx. Summer Grape. Hodenpyl, Havemeyer.

Vitis Coignetiae Pulliatt. Glory Vine. Hodenpyl, Hicks, Havemeyer.

Vitis Labrusca L. Fox Grape. DeForest, Huntington Road, C. S. H.

ORDER XXVI. MALVALES.

TILIACEAE.

Tilia americana L. (*T. glabra* Vent.) Linden, Matheson, Bailey, Willys, DeForest, Hicks, Havemeyer.

Tilia cordata Mill. Small-leaved Linden. Hicks, Matheson, Pratt. Var: *cordifolia* (Heartleaf European Linden), Willys.

Tilia euchlora Koch. Crimean Linden. Hodenpyl.

Tilia flavescens Hort. Yellow Linden. Matheson.

Tilia heterophylla Vent. Beetree Linden. Bailey.

Tilia petiolaris Hook. Weeping Linden. Willys.

Tilia platyphyllos Scop. Large-leaved Lime. Bailey, Matheson, Hicks.

Tilia tomentosa Moench. White Linden. Matheson. Var: *spectabilis* Ait. Showy Linden. Hicks. Var: *pendula* Hook. Matheson, Hicks.

Tilia vulgaris Hayne. Matheson, Hicks.

MALVACEAE.

Althaea officinalis L. Marsh Mallow. Matheson, Bailey, Tiffany, Hodenpyl.

Althaea rosea Cav. Hollyhock. Matheson, DeForest, Tiffany, Bailey, Hicks, Havemeyer, Pratt, Country Life Press. Var: *"Beatrice coerulea"* Hort., Hodenpyl; var: *"Newport Pink Hollyhock"* Hort., Matheson.

Callirhöe involucrata Gray. Poppy Mallow. Hicks, Hodenpyl.
Hibiscus esculentus L. Okra. Havemeyer, Laughlin's garden, C. S. H.
Hibiscus Moscheutos L. Common Rose Mallow. Bailey, Tiffany, Matheson, Hodenpyl, Hicks.
Hibiscus oculiroseus Britt. Marsh, C. S. H., Laboratory Grounds, C. S. H.
Hibiscus syriacus L. Rose of Sharon. Bailey, DeForest, Hicks, Tiffany, Havemeyer.
Lavatera sp? Tree mallow. Matheson, Bailey.
Malva involucrata A. Gray Purple Mallow. Sanderson estate, Locust Valley.
Malva moschata L. Musk Mallow. C. S. H. Village.
Sidalcea candida Gray. White Prairie Mallow. Hicks.
Sidalcea malvaeflora Gray. Checkerbloom. Havemeyer.

ORDER XXVII. PARIETALES (INCLUDING VIOLALES).

DILLENIACEAE.

Actinidea arguta Miq. Matheson, Hicks, Havemeyer.
Actinidia chinensis Planch. Yangtao. Hodenpyl.
Actinidia Kolomikta Maxim. Havemeyer.
Actinidia melanandra Franch. Hodenpyl.
Actinidia polygama Maxim. Silver Vine. Hodenpyl, Matheson.
Actinidia Wilsoni Hort. Hodenpyl.

TERNSTROEMIACEAE.

Camellia japonica L. Common Camellia. Tiffany.
Franklinia alatamaha Marsh (*Gordonia alatamaha* Sarg.) Gordonia. Bailey, Hicks.
Stewartia pentagyna L. Her. Mountain Stewartia. Hodenpyl, Bailey.
Stewartia Pseudo-Camellia Maxim. Japanese Stewartia. Hodenpyl, Hicks, Bailey, Havemeyer.

GUTTIFERAE.

Hypericum aureum Bartram. Golden St. Johnswort. Hodenpyl.
Hypericum Bucklei M. M. Curtis. Mountain St. Johnswort. Hodenpyl.

Hypericum calycinum L. Aarons Beard. Hodenpyl, Havemeyer.
Hypericum densiflorum Pursh. Havemeyer.
Hypericum Kalmianum L. Kalm Hypericum. Hodenpyl.
Hypericum Moserianum Andre. Gold Flower. Matheson, DeForest, Hodenpyl, Hicks.
Hypericum patulum Thunb. Japanese Hypericum. Var. *Henryi* Veitch. Hodenpyl, Havemeyer; var. *uralum* Koehne, St. Johnswort. Hodenpyl.
Hypericum splendens Hort. Hodenpyl.
Hypericum prolificum L. Shrubby St. Johnswort. Hodenpyl.
Hypericum repens Hort. Country Life Press.

TAMARICACEAE.

Tamarix africana Hort. African Tamarix (*T. parviflora* DC.) Hicks, Bailey.
Tamarix gallica L. French Tamarisk. Havemeyer, Matheson.
Tamarix hispida Willd. Kashgar Tamarix. Havemeyer.
Tamarix pentandra Pall. Firestamen Tamarix. Matheson.
Tamarix tetrandra Pall. Fourstamen Tamarix. Bailey.

CISTACEAE.

Cistus laurifolius L. Laurel Rockrose. Hodenpyl.
Helianthemum Chamaecistus Mill. Common Sunrose. Bailey, DeForest, Hicks, Havemeyer; var. *tomentosum* Hort. (Rosemary Sunrose), Hodenpyl.
Helianthemum roseum Hort. Red Sun Rose. Country Life Press.

VIOLACEAE.

Viola blanda Willd. Sweet White Violet. DeForest.
Viola canadensis L. Canada Violet. Hodenpyl.
Viola conspersa Reichenb. Hodenpyl.
Viola cornuta L. Horned Violet. Tiffany, Matheson, DeForest, Hodenpyl, Hicks, Havemeyer; var. *G. Wermia* Hort. DeForest; var. Yellow Gold (*carnata lutea* Hort.), Hodenpyl.
Viola cucullata Ait. Blue Marsh Violet. Hodenpyl.
Viola gracilis Sibth. and Smith. Country Life Press.

Viola lutea Huds. European Yellow Violet. Matheson.
Viola odorata L. Sweet Violet. Hodenpyl, Havemeyer.
Viola pedata L. Birds Foot Violet. Hodenpyl. Country Life Press; var. *bicolor* Hort. Country Life Press.
Viola pubescens Ait. Downy Yellow Violet. Hodenpyl.
Viola rotundifolia Michx. Roundleaf Violet. Hodenpyl.
Viola sagittata Ait. Arrowleaf Violet. Hodenpyl.
Viola septentrionalis Greene. Northern Blue Violet. Hodenpyl.
Viola tricolor L. var. *hortensis* DC. Pansy. Havemeyer.

BEGONIACEAE.

Begonia gracilis H. B. K. Slender Begonia. Tiffany.
Begonia Rex Putz. Fish Hatchery, C. S. H. Tiffany.
Begonia socotrana Hook. Var. *Gloire de Lorraine* Hort. Bailey, Willys; var. *Melior* Hort. Willys, Vernon, Tiffany.

ORDER XXVIII. OPUNTIALES.

CACTACEAE.

Echinocastus lorijonthalonius Hort. Hodenpyl.
Echinocactus lepisacanthos Hort. Hodenpyl.
Epiphyllum sp? Fish Hatchery, C. S. H.
Opuntia arenaria Engelm. Sand Cactus. Tiffany, Hodenpyl.
Opuntia basilaris Engelm and Begel. Beavertail Cactus. Tiffany.
Opuntia fragilis Haw. Hodenpyl.
Opuntia imbricata P. DC. Walking Stick Cactus. Tiffany, Hodenpyl.
Opuntia polyacantha Hort. Hodenpyl.
Opuntia vulgaris Mill. DeForest, Hicks. Country Life Press.

ORDER XXIX. MYRTIFLORAE.

THYMELAEACEAE.

Daphne Cneorum L. Rose Daphne. Bailey, DeForest, Hodenpyl, Hicks, Havemeyer, Country Life Press.
Daphne Genkwa Sieb. & Zucc. Lilac Daphne. DeForest, Hodenpyl, Havemeyer.
Daphne Mezereum L. February Daphne. Havemeyer.

Daphne odora Thunb. Winter Daphne. Havemeyer.
Dirca palustris L. Leatherwood or wicopy. Bailey, Willys, Hicks.

ELAEAGNACEAE.

Elaeagnus angustifolia L. Russian Olive. Bailey, Hodenpyl, Hicks.
Elaeagnus argentea Pursh. Silverberry. Hodenpyl.
Elaeagnus fruitlandi Hort. Hodenpyl.
Elaeagnus longpipes Gray. (*E. multiflora* Thunb.) Cherry Elaeagnus. Bailey, Matheson, DeForest, Hodenpyl, Hicks, Pratt.
Elaeagnus pungens Thunb. Thorny Elaeagnus. Hodenpyl.
Elaeagnus umbellata Thunb. Autumn Elaeagnus. Bailey, Hodenpyl.
Hippaphaë rhamnoides L. Common Sea Buckthorn. Bailey, Matheson, Hodenpyl.
Shepherdia argentea Nutt. Silver Buffalo Berry. Bailey.

LYTHRACEAE.

Lagerstroemia Sp? Crape Myrtle. Bailey.
Lythrum Salicaria L. Purple Loose Strife. Hicks, Matheson, Hodenpyl. Var. *roseum* Hort. (Rose Loose Strife), Matheson, DeForest, Hodenpyl.

PUNICACEAE.

Punica Granatum L. Pomegranate. Bailey, DeForest.

MYRTACEAE.

Pimenta officinalis Berg. Allspice. DeForest.

MELASTOMACEAE.

Medinilla magnifica Lindl. Tiffany.
Rhexia virginica L. Common Meadow Beauty. Hodenpyl.

ONAGRACEAE.

Clarkia elegans Dougl. Bailey, Tiffany.
Epilobium angustifolium L. Fireweed. Hodenpyl.
Fuchsia speciosa Hort. (*F. hybrida* Voss) Common Fuchsia. Tiffany, Kahn, Pratt; var. *magellanica corallina* (Coral Fuchsia), Willys.

Godetia sp? Bailey.
Oenothera biennis L. Common Evening Primrose. Bailey. Var. *grandiflora* Lindl. (*Lamarckiana* Serg.), Bailey, Hodenpyl.
Oenothera brachycarpa Gray. Tiffany, Hodenpyl.
Oenothera caespitosa Nutt. Tufted Evening Primrose. Hodenpyl.
Oenothera fruticosa L. Sundrops. Havemeyer; var. *Youngi* Hort. Young's Sundrops. Matheson, Hodenpyl, DeForest, Hicks, Country Life Press.
Oenothera glauca Michx. Pratt. Var. *Fraseri* Hort. Fraser Sundrops. DeForest.
Oenothera Missouriensis Sims. Ozark Sundrops. DeForest.
Oenothera speciosa Nutt. Hodenpyl.

HALORRAGADACEAE.

Gunnera chilensis Lam. Chilean Gunnera. Hodenpyl.

ORDER XXX. UMBELLIFLORAE (UMBELLALES).

ARALIACEAE.

Acanthopanax divaricatum Seem. Hodenpyl.
Acanthopanax pentaphyllum March. Matheson, DeForest, Bailey, Hicks, Havemeyer.
Acanthopanax ricinifolium Seem. Castor-Aralia. Hodenpyl, Bailey, Hicks; var. *Maximowiczi* Hort. Bailey.
Aralia chinensis L. Chinese Angelica. Havemeyer; var. *mandschurica* Rehd. Bailey.
Aralia cordata Thunb. Udo. Hicks, Matheson, Hodenpyl.
Aralia nudicalis L. Wild Sarsaparilla. Hodenpyl.
Aralia racemosa L. American Spikenard. Hodenpyl.
Aralia spinosa L. Hercules Club. Hodenpyl, Bailey, Hicks, Havemeyer.
Fatsia japonica Decne and Planch. Tiffany, Bailey.
Hedera helix L. True English Ivy. Bailey, Tiffany, Kahn, Havemeyer, DeForest, Hodenpyl, Hicks, Willys.
Panax quinquefolium L. American Ginseng. Hodenpyl, Bailey.

UMBELLIFERAE.

Aegopodium Podograria L. Goutweed. Kahn.

Daucus Carota L. var. *sativa* DC. Cultivated Carrot. C. S. H. vicinity.

Eryngium alpinum L. Blue Top Eryngo. Havemeyer.

Eryngium amethystinum L. Amethyst Eryngo. Bailey, Country Life Press.

Eryngium maritimum L. Seaholly. Bailey, Matheson.

Ferula communis L. Giant Fennel. Hodenpyl.

Heracleum villosum Fish. Caucasian Cow Parsnip. DeForest, Hodenpyl.

Myrrhis odorata Scop. Myrrh. Havemeyer.

CORNACEAE.

Aucuba japonica Thunb. Havemeyer, Pratt; var. *variegata* Hort. Gold dust Acuba. Matheson.

Cornus alba L. Tartarian Dogwood. Tiffany, Willys, Kahn, DeForest, Hodenpyl, Bailey; var. *sibirica* Lodd. Hodenpyl, Matheson; var. *argenteo marginata* Hort. Bailey.

Cornus alternifolia L. Pagoda Dogwood. Hodenpyl, Pratt.

Cornus Arnoldiana Hort. Hodenpyl.

Cornus Amomum Mill. Silky Dogwood. Hodenpyl.

Cornus brachypoda Auth. Hodenpyl, Hicks.

Cornus Canadensis L. Bunch Berry. Bailey, Hodenpyl.

Cornus controversa Hemsl. Giant Dogwood. Hodenpyl.

Cornus florida L. Flowering Dogwood. Bailey, Hodenpyl, Matheson, Kahn, DeForest, Hicks, Havemeyer, Pratt; var. *rubra* Hort. DeForest, Hodenpyl, Bailey, Matheson.

Cornus Kousa Buerg. Kousa Dogwood. Bailey, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt.

Cornus mas L. Cornelian Cherry. Matheson, Bailey, DeForest, Hodenpyl, Hicks, Havemeyer; var. *aureo-elegantissima* Hort. Bailey.

Cornus officinalis Sieb. and Zucc. Japanese Cornelian Cherry. Matheson.

Cornus paniculata L'Herit. Gray Dogwood. Hodenpyl, Hicks.

Cornus paucinervis Hance. Littleleaf Dogwood. Bailey, Hodenpyl, Hicks.

Cornus rugosa Lam. Roundleaf Dogwood. Hodenpyl.

Cornus sanguinea L. Blood Twig Dogwood. Tiffany, Matheson, DeForest, Hodenpyl, Hicks, Bailey, Havemeyer.

Cornus stolonifera Michx. Red osier Dogwood. Matheson, DeForest, Hodenpyl, Tiffany, Bailey, Hicks, Pratt, Havemeyer.

Cornus zanthocarpa forma nova Hort. Hodenpyl.

Davidia involucrata Baill. Dove Tree. Bailey.

Nyssa sylvatica Marsh. Tupelo. Bailey, Willys, Hodenpyl, Hicks.

SUB-CLASS. METACHLAMYDEAE (SYMPETALAE).

ORDER I. ERICALFS.

DIAPENSIACEAE.

Galax aphylla L. Galax. DeForest, Hodenpyl.

Shortia galacifolia Torr. and Gray. Oconee Bells. DeForest, Bailey, Hicks, Hodenpyl.

CLETHRACEAE.

Clethra acuminata Michx. Cinnamon Clethra. Hicks.

Clethra alnifolia L. Sweet Pepperbush. Matheson, Hicks, DeForest, Hodenpyl, Pratt.

ERICACEAE.

Arbutus Unedo L. Strawberry Tree. Havemeyer.

Arctostaphylos Uva-ursi Spreng. Bear Berry. DeForest, Bailey, Hicks, Havemeyer, Country Life Press.

Azalea arborescens Pursh. Sweet Azalea. Bailey, Hodenpyl, DeForest, Hicks.

Azalea calendulacea Michx. (*Rhododendron calendulaceum* Torr.) Flame Azalea. Bailey, Hodenpyl, DeForest, Hicks, Havemeyer.

Azalea Gandavensis Hort. Ghent Azalea. Bailey, Hicks, Westbury.

Azalea indica L. (*Rhododendron indicum* Sweet) Bailey, Hicks, Havemeyer, Pratt; var. *rosiflora* Rehd. (*balsaminaeflora*

Carr.) Pratt; var. *amoena* Hort., Tiffany, DeForest, Hodenpyl, Hicks; var. *fujimange,* Country Life Press; var. *Kaempfferi* Rehder, Japanese Mountain Azalea. DeForest, Hodenpyl, Bailey, Hicks, Country Life Press.

Azalea japonica Gray (*Rhododendron japonicum* Suringar) Japanese Azalea. DeForest, Hodenpyl, Bailey, Tiffany, Hicks, Havemeyer.

Azalea ledifolia Hook (*Rhododendron mucronatum* Don.) Willys, DeForest, Hodenpyl, Bailey, Kahn, Havemeyer; var. *rosea pallida* Hort., Country Life Press.

Azalea linearifolia Hook. Spider Azalea. Hodenpyl; var. *macrocephalum forma decandrum* Hort. Hodenpyl.

Azalea loisleuria Hort. Hodenpyl.

Azalea macrocephalum Hort. Hodenpyl.

Azalea mollis Blume. (*Rhododendron molle* Don.) Chinese Azalea. DeForest, Tiffany, Hodenpyl, Bailey, Hicks, Havemeyer.

Azalea mucronulatum Turcz. var. *ciliatum* Hort. Hodenpyl.

Azalea nudiflora L. (*Rhododendron nudiflorum* Torr.) Pinxterbloom. Matheson, DeForest, Hodenpyl, Bailey, Hicks, Pratt, Country Life Press; var. *canescens* Rehder, Piedmont Azalea. Bailey, Hodenpyl, DeForest, Hicks.

Azalea oblongifolium Hort. Hodenpyl.

Azalea obtusa Lindl. Hiryu Azalea. Hodenpyl. Var. *kiusiana* Hort., Kyushu Azalea. Bailey, Hicks; var. *hinodegiri* Hort., Hinodegiri Azalea. Bailey, Hodenpyl, DeForest, Hicks, Country Life Press.

Azalea occidentalis Torr. & Gray (*Rhododendron occidentale* Gray), Havemeyer.

Azalea pontica L. (*Rhododendron luteum* Sweet) Pontic Azalea. Bailey, Hodenpyl, Havemeyer; var. *yodogawa* Rehd. Bailey, DeForest, Hicks.

Azalea poukhanensis Korean Azalea. Bailey, Hodenpyl, Hicks.

Azalea prunifolium Hort. Hodenpyl.

Azalea Schlippenbachi Kuntze (*Rhododendron Schlippenbachii* Maxim) Royal Azalea. Bailey, Hodenpyl, DeForest, Hicks, Havemeyer.

Azalea rustica flore pleno Hort. Hodenpyl.

Azalea Tchonoskii Hort. Hodenpyl.

Azalea Vaseyi Rehd. (*Rhododendron Vaseyi* Gray) Pinkshell Azalea. Bailey, Hodenpyl, Matheson, DeForest, Hicks, Havemeyer, Country Life Press.

Azalea viscosa L. (*Rhododendron viscosum* Torr.) Swamp Azalea. Bailey, Hodenpyl, Tiffany, DeForest, Matheson, Hicks, Havemeyer.

Azalea Weyrichii Hort. Hodenpyl.

Azalea—Horticultural varieties—Altaclare (*mollis x viscosa*), Hodenpyl; Louisa Hunnewell, Hodenpyl, DeForest; Firefly, Country Life Press.

Calluna vulgaris Salisb. Scotch Heather. Hodenpyl, DeForest; var. *alba hammondi* Hort. Bailey, Hodenpyl, DeForest, Hicks, Matheson, Country Life Press; var. *Alporti* Kirchner, Alport Heather, DeForest; var. *rubra* Hort., Red Heather, Matheson; var. *scarlei*, Scarlet Heather, Hodenpyl; var. *rosea*, Country Life Press; var. *purpurea* Hort., Hodenpyl.

Chamaedaphne calyculata (L) Moench. Hodenpyl, Bailey, Hicks, DeForest.

Chimaphila maculata (L.) Pursh. Striped Pipsissewa. DeForest, Hodenpyl.

Chimaphila umbellata (L.) Nutt. Common Pipsissewa. DeForest, Bailey.

Chiogenes hispidula Torr. and Gray. Hodenpyl.

Enkianthus campanulatus Nichols. Redvein Enkianthus. Bailey, Hodenpyl, DeForest, Hicks, Havemeyer.

Enkianthus perulatus Schneid. White Enkianthus. Bailey, Hodenpyl, DeForest, Havemeyer.

Epigaea repens L. Trailing Arbutus. DeForest, Hodenpyl, Bailey, Tiffany, Hicks, Havemeyer.

Erica carnea L. Spring Heath. Bailey, Matheson, DeForest, Havemeyer, Country Life Press; var. *alba* Hort., Country Life Press.

Erica cinerea L. Twisted Heath. DeForest.

Erica mediterranea L. Biscay Heath. Hodenpyl, Hicks, Havemeyer.

Erica stricta Donn. Corsican Heath. Havemeyer.

Erica Tetralix L. Crossleaf Heath. Havemeyer.

Erica vagans L. Cornish Heath. DeForest, Hodenpyl.

Gaultheria procumbens L. Wintergreen. DeForest, Hodenpyl, Hicks.

Gaultheria Shallon Pursh. Salal. Hodenpyl

Gaylussacia baccata (Wang) C. Koch. Black Huckleberry. Hicks.

Gaylussacia brachycera (Michx.) Gray Box Huckleberry. DeForest, Hodenpyl, Hicks, Country Life Press.

Kalmia angustifolia L. Lambkill. Hicks, Havemeyer, Country Life Press.

Kalmia latifolia L. Mountain Laurel. Tiffany, Matheson, C. S. H., Bailey, Kahn, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt, Country Life Press.

Kalmia polifolia Wang. (*K. glauca* Ait.) Bog Kalmia. DeForest, Hodenpyl, Havemeyer.

Ledum groenlandicum Oeder. True Labrador Tea. Bailey, Hodenpyl, Hicks.

Ledum palustre L. Crystal Tea. Hodenpyl.

Leiophyllum buxifolium Ell. (*Ledum buxifolium* Berg.), DeForest, Hodenpyl, Country Life Press. Var. *prostratum* Gray, Allegheny Sand Myrtle, Willys, Hodenpyl, Country Life Press; var. *Hugeri* Hort., Hodenpyl.

Leucothöe axillaris Don. Havemeyer, Country Life Press.

Leucothöe Catesbaei Gray. Drooping Leucothoe. Bailey, Tiffany, Hodenpyl, Matheson, DeForest, Hicks, Havemeyer, Pratt, Country Life Press.

Leucathöe populifolia Dipp. DeForest.

Oxydendrum arboreum DC. Sour Wood. DeForest, C. S. H. station, Bailey, Hicks, Havemeyer.

Pernettia mucronata Gaud. Havemeyer.

Pieris floribunda Benth. Mountain Andromenda. Matheson, DeForest, Hodenpyl, Tiffany, Bailey, Hicks, Havemeyer, Country Life Press.

Pieris japonica D. Donn. Japanese Andromeda. Matheson,

Hodenpyl, DeForest, Tiffany, Bailey, Hicks, Havemeyer, Pratt, Country Life Press.

Pieris mariana L. D. Don. Hodenpyl, Hicks.

Pyrola asarifolia Michx. var. *incarnata* (Fisch) Fernald. Hodenpyl.

Pyrola rotundifolia Man. (*P. Americana* Sweet) European Pyrola. Hodenpyl.

Pyrola umbellata Hort. Hodenpyl.

Rhododendron arboreum Sm. Tree Rhododendron. Havemeyer.

Rhododendron carolinianum Rehd. Carolina Rhododendron. Willys, Tiffany, Matheson, DeForest, Hodenpyl, Hicks, Havemeyer. Var. *album* Hort. (White Carolina Rhododendron) Matheson, DeForest, Hodenpyl.

Rhododendron arbutifolium Hort. Wilson's Rhododendron. Country Life Press.

Rhododendron catawbiense Michx. Catawba Rhododendron. Matheson, Tiffany, DeForest, Hodenpyl, Hicks, Havemeyer.

Rhododendron ferrugineum L. Rock Rhodendron. DeForest, Hodenpyl, Bailey.

Rhododendron hirsutum L. Garland Rhododendron. DeForest, Hodenpyl.

Rhododendron maximum L. Great Laurel. DeForest. Laboratory grounds C. S. H., Hodenpyl, Hicks, Havemeyer, Pratt.

Rhododendron micranthum Turcz. Manchurian Rhododendron. Havemeyer.

Rhododendron minus Michx. Piedmont Rhododendron. DeForest, Hodenpyl, Country Life Press.

Rhododendron ponticum L. Pontic Rhododendron. Havemeyer.

Rhododendron racemosum Franch. Mayflower Rhoddcendron. DeForest.

Rhododendron rubiginosum Franch. Bailey.

Rhododendron Tachonoskii Maxim. Hodenpyl.

Rhododendrum horticultural varieties:

Abraham Lincoln. **Bailey.**
Album Elegans. **Cat., DeForest, Hodenpyl.**
Boule de Neige. **Cat., DeForest, Hodenpyl.**
H. W. Sargent. **Hodenpyl.**

Caractacus. Cat. DeForest, Hodenpyl.
Charles Bagley. Cat. Hodenpyl.
Charles Dickens. Cat. DeForest, Hodenpyl.
C. S. Sargent. Cat. DeForest.
Daphne. (*Ferrugineum x carolinanum*) Hodenpyl.
Delicatissimum. (*Maximum x catawbiense*). DeForest, Hodenpyl.
E. S. Rand. Cat. Hodenpyl.
Everest Cat. DeForest, Hodenpyl.
F. D. Godman. Cat. Hodenpyl.
General Grant. Cat. Hodenpyl.
Giant Cat. Hodenpyl.
Henrietta Sargent. Cat. DeForest.
H. N. Hunnewell. Cat. Hodenpyl.
H. W. Sargent. Cat. DeForest.
Kettledrum. Cat. DeForest, Hodenpyl.
Lady Armstrong. Cat. DeForest, Hodenpyl.
Lady Clermont Cat. DeForest.
Mrs. Milner. Cat. Hodenpyl.
Parsons Grandiflorum. Cat. DeForest, Hodenpyl.
Purpureum Elegans. Cat. Hodenpyl.
Wilson Rhododendron (*Ferrugineum* x *minus*) DeForest, Hodenpyl.
pyl.

Rhodora canadensis L. (*Rhododendron canadense* L. B. S. P. Rhodora), Bailey, DeForest, Hodenpyl, Hicks.

Vaccinium arboreum Marshall. Hodenpyl.

Vaccinium corymbosum L. High Bush. DeForest, Hodenpyl, Bailey, Hicks, Havemeyer; var. *pallidum* Gray. Blue Ridge Blueberry. Hodenpyl.

Vaccinium macrocarpon Ait. Cranberry. DeForest, Hodenpyl, Bailey.

Vaccinium ovatum Pursh. Box Blueberry. DeForest.

Vaccinium pennsylvanicum Lam. Low Blueberry. Bailey, Hempstead Plain, Hodenpyl, Havemeyer.

Vaccinum stamineum L. Deerberry. Hodenpyl, Havemeyer.

Vaccinium vacillans Kalm. Dryland Blueberry. Hodenpyl.

Vaccinium Vitis Idaea L. Cowberry Mountain Cranberry. DeForest, Hodenpyl, Havemeyer, Country Life Press; var. *buxifolia* Hort.; *major* Hort. and *ovatum* Hort. Hodenpyl.

Zenobia pulverulenta Pollard. Dusty Zenobia. Havemeyer, Country Life Press.

ORDER II. PRIMULAIES.

MYRSINACEAE.

Ardisia crenulata Lodd. (*A. crispa* A. D. C.) Coral Ardisia. Tiffany.

PRIMULACEAE.

Anagallis arvensis L. Poor Man's Weatherglass. Carnegie Institution, C. S. H.

Androsace lanuginosa Wall. Rock Jasmine. Havemeyer.

Androsace sarmentosa Wall. Havemeyer.

Cyclamen persicum Mill. (C. indicum L.) Persian Cyclamen. Willys.

Dodecatheon Meadia L. Common Shooting Star. Bailey, Hodenpyl, Pratt.

Lysimachia clethroides Duby. Lizard's Tail. Hodenpyl, Matheson, Pratt, DeForest.

Lysimachia Nummularia L. Moneywort. Matheson, C. S. H. vicinity.

Primula acaulis Hill (*P. vulgaris* Huds.) English Primose. Bailey, Matheson, DeForest, Hodenpyl, Havemeyer.

Primula Auricula L. Auricula. Havemeyer.

Primula elatior Hill. Oxlip Primrose. Hicks.

Primula japonica Gray. Japanese Primrose. Havemeyer, Country Life Press.

Primula malacoides Franch. Fairy Primrose. Kahn, Willys.

Primula obconica Hance. Top Primrose. Tiffany, Willys.

Primula polyantha Mill. Polyanthus Primrose. Hicks, Havemeyer.

Primula pulverulenta Duthie. Silverdust Primose. Havemeyer.

Primula Sieboldi Morr. Siebold Primrose. Havemeyer.

Primula Sinensis Lindl. Chinese Primrose. Tiffany.

Primula veris L. Cowslip Primrose. Bailey, Tiffany, Matheson, Kahn, Hicks, Havemeyer.

Steironema ciliatum (L.) Raf. Hodenpyl.

Trientalis americana (Pers.) Pursh. American Starflower. Hodenpyl.

ORDER III. PLUMBAGINALES.

PLUMBAGINACEAE.

Ceratostigma carpentae Hort. Lady Carpent's Leadwort. Country Life Press.

Ceratostigma plumbaginoides Bunge. Larpente Plumbago. Hodenpyl, Tiffany, Matheson, DeForest, Bailey, Hicks.

Limonium (*Statice*) *latifolium* Kintze. Bigleaf Sea Lavender. Hodenpyl, Matheson, DeForest, Bailey, Pratt, Havemeyer, Country Life Press.

Limonium (*Statice*) *Suworowi* Kuntze. Bailey, Pratt.

Limonium (*Statice*) *tataricum* var. *angustifolium* Hubb. Lanceleaf Sea Lavender. DeForest.

Plumbago capensis Thunb. Havemeyer.

Statice Armeria L. Common Thrift. Tiffany, DeForest, Hodenpyl; var. *laucheana* Hubb. Country Life Press; var. *alba* Hort. Country Life Press.

ORDER IV. EBENALES.

SAPOTACEAE.

Achras Zapota (*Sapota Achras* Mill.) Sapodilla. Matheson.

EBENACEAE.

Diospyros virginiana L. Persimmon. C. S. H. vicinity, Matheson, Hodenpyl, Hicks.

STYRACACEAE.

Halesia monticola Hort. Mountain Silverbell . Hicks.

Halesia tetraptera L. (*H. carolina* L.) Great Silverbell. Hicks, DeForest, Hodenpyl, Havemeyer, Pratt.

Pterostyrax hispida Sieb. & Zucc. Fragrant Epaulette Tree. Bailey, Hodenpyl, Hicks.

Styrax japonica Sieb. & Zucc. Japanese Snowbell. DeForest, Bailey, Matheson, Davenport, Hodenpyl, Hicks, Havemeyer, Country Life Press.

Styrax Obassia Sieb. & Zucc. Fragrant Snowbell. Bailey, Hicks, Havemeyer, Dana Island.

Symplocos paniculata Wall. (*S. crataegoides* Buch.) Asiatic Sweetleaf. Hodenpyl, Hicks, Bailey.

ORDER V. CONTORTAE (GENTIANALES).

OLEACEAE.

Chionanthus retusa Lindl. Chinese Fringe Tree. Hodenpyl.

Chionanthus virginica L. White Fringe Tree. Havemeyer, Matheson, Willys, Hodenpyl, Bailey, DeForest, Dana Island.

Forsythia europaea Deg. and Bald. Albanian Forsythia. Hodenpyl.

Forsythia intermedia Zabel. Havemeyer; var. *primulina* Hort. Havemeyer.

Forsythia ovata Hort. Hodenpyl.

Forsythia suspensa Vahl. Golden Bell. Matheson, Kahn, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt. Davenport, C. S. H.; var. *Fortunei* Rehder (Fortune Forsythia), Bailey, Matheson, Tiffany, Kahn, Hodenpyl, DeForest, Hicks; var. *primulina* Hort. (Primose Forsythia), Hodenpyl.

Forsythia viridissima Lindl. Greenstem Forsythia. Havemeyer, Pratt, Willys, DeForest, Matheson, Hodenpyl, Tiffany, Hicks.

Fraxinus americana L. White Ash. Fish hatchery, C. S. H., Matheson, Bailey, Hodenpyl, Hicks.

Fraxinus americana var. *aecidosium* Shull. Huntington Road, C. S. H.

Fraxinus Bungeana DC. Bailey.

Fraxinus cuspidata Torr. Fragrant Ash. Bailey.

Fraxinus excelsior L. European Ash. Matheson, Bailey.

Fraxinus Ornus L. Flowering Ash. Bailey, Havemeyer.

Jasminum Beesianum Forrest & Diels. Rosy Jasmine. Havemeyer.

Jasminum nudiflorum Lindl. Winter Jasmine. Hicks, DeForest.

Ligustrum amurense Carr. Amur Privet. Bailey, Hicks.

Ligustrum excelsum superbum Hort. Silverleaf Privet. Bailey.

Ligustrum Ibota Sieb. Ibota Privet. DeForest, Hodenpyl, Hicks; var. *Regelianum* Rehd. (Regel Privet), Matheson, Hicks.

Ligustrum japonicum Thunb. Japanese Privet. C. S. H. vicinity.

Ligustrum lucidum Ait. var. *superbum* Hort. Silverleaf Privet. Bailey.

Ligustrum ovalifolium Hassk. California Privet. Tiffany, Matheson, DeForest, Hicks.

Ligustrum vulgare L. Common Privet. Matheson, Hicks, Blackford Hall, C. S. H. Tiffany, Willys.

Osmanthus Aquifolium Sieb. Holly Osmanthus. Havemeyer.

Syringa affinis L. Henry Early Lilac. Bailey, Willys; var. *Giraldi* Hort. (Purple Early Lilac), Willys, Tiffany, Bailey.

Syringa Amurensis Rupr. Amurian Lilac. Havemeyer, Hodenpyl, Dovenport, C. S. H. vicinity.

Syringa Chinensis Willd. Chinese Lilac. Havemeyer.

Syringa formosissima Hort. Hodenpyl.

Syringa japonica Decne (*S. amurensis*, var. *japonica* Franch & Sav.) Japanese Tree Lilac. Bailey, Matheson, DeForest, Hodenpyl.

Syringa Josikaea Jacq. Hungarian Lilac. Bailey, Matheson, Hodenpyl, Havemeyer.

Syringa Julianae Schneid. Juliana Lilac. Hodenpyl.

Syringa Kamibayaski Hort. Hodenpyl.

Syringa komarovi sargentiana Hort. Sargent Liliac. Hodenpyl.

Syringa pekinensis Rupr. (*S. amurensis* var. *pekinensis* Maxim.) Peking Lilac. Hodenpyl.

Syringa persica L. Persian Lilac. Bailey, Matheson, Hicks, Havemeyer, Pratt.

Syringa pubescens Turcz. Hairy Lilac. Hodenpyl.

Syringa reflexa Hort. Nodding Lilac. Hodenpyl, Hicks.

Syringa sweginzowi Hort. Chengtu Lilac. Hodenpyl.

Syringa velutina. Hodenpyl.

Syringa villosa Vahl. Late Lilac. Bailey, Hodenpyl, Hicks, Havemeyer, Pratt; var. *emodi* Rehd. Himalaya Lilac. Matheson, Hicks.

Syringa vulgaris L. Common Lilac. Tiffany, Willys, Fish hatchery, C. S. H., Matheson, Hicks, Havemeyer, Pratt; var. *alba* Hort. (Common White Lilac), Willys.

Syringa Wilsoni Hort. Wilson Lilac. Hodenpyl.

Syringa Wolfi Hort. Wolf Lilac. Hodenpyl.

Syringa yunnanensis Hort. Yunnan Lilac. Hodenpyl.

Syringa vulgaris—horticultural varieties:

Alphonse Lavallee. Hodenpyl.
Charles Joly. Hodenpyl.
Comtesse Horace de Choiseul. Hodenpyl.
Condorcet. Hodenpyl.
de Humboldt. Hodenpyl.
De Groncels. Hodenpyl.
Doyen Keteleer. Hodenpyl.
Frau Bertha Dammann. Hodenpyl.
Geheimrat Singelmann. Hodenpyl.
Glorie de Loraine. Hodenpyl.
Jacques Callot. Hodenpyl.
Jean Bart. Hodenpyl.
La Mauve. Hodenpyl.
La Tour d'Auvergne. Hodenpyl.
La Marck. Hodenpyl.
Linne. Hodenpyl.
Louis Van Houtte. Hodenpyl.
Louvain. Hodenpyl.
Ludwig Spaeth. Hodenpyl.
Marechal de Bassompierre. Hodenpyl.
Marie Legraye. Hodenpyl.
Monument Carnot. Hodenpyl.
President Grevy. Hodenpyl.
Prince de Beauvau. Hodenpyl.
Prince of Wales. Hodenpyl.
Professor Sargent. Hodenpyl.
Red Marly. Hodenpyl.
Rouge de Trianon. Hodenpyl.
Senateur Volland. Hodenpyl.
Thibaut. Hodenpyl.
Virginalis. Hodenpyl.

LOGANIACEAE.

Buddleia asiatica Lour. White Butterfly Bush. Bailey, Willys, Kahn, Havemeyer, Pratt.

Buddleia Davidi Franch. Havemeyer, Pratt. Var. *magnifica* Rehd. & Wils. Oxeye Butterfly Bush. Hodenpyl, Havemeyer, Country Life Press; var. *superba* Rehd. & Wils. Hodenpyl, Bailey, DeForest, Willys, Hicks; var. *Veitchiana* Rehd. Veitch Butterfly Bush. Hodenpyl, Bailey, Tiffany, Kahn, DeForest; var. *Wilsonii* Rehd. & Wilson. Wilson Butterfly Bush. Hodenpyl; var. "Eva Dudley," Hodenpyl.

Buddleia officinalis Maxim. Matheson, Kahn, Hodenpyl.

Buddleia Farquharii Hort. Hodenpyl.

Spigelia marilandica L. Pinkroot. Hodenpyl.

GENTIANACEAE.

Gentiana acaulis L. Stemless Gentian. Hodenpyl.

Gentiana Andrewsi Griseb. Closed Gentian. DeForest, Hodenpyl.

Gentiana asclepiadea L. Milkweed Gentian. Hodenpyl.

Gentiana crinita Froel. Fringed Gentian. Hodenpyl.

Menyanthes trifoliata L. Common Bogbean. Hodenpyl.

APOCYNACEAE.

Allamanda cathartica L. Common Allamanda. Tiffany.

Nerium sp? Oleander. Tiffany, Matheson.

Nerium Oleander L. Oleander. DeForest.

Vinca major L. Blackford Hall. C. S. H.

Vinca minor L. Common Periwinkle. Bailey, Tiffany, Matheson, Kahn, DeForest, Hodenpyl, Hicks, Pratt.

Vinca rosea L. Madagascar Periwinkle. C. S. H. vicinity.

Vinca virginica Hort. Hodenpyl.

ASCLEPIADACEAE.

Asclepias curassavica L. Blood-Flower. DeForest.

Asclepias incarnata L. Swamp Milkweed. Hodenpyl, Bailey.

Asclepias pulchra Ehrb. Hairy Milkweed. Hodenpyl.

Asclepias tuberosa L. Butterfly Weed. DeForest, Hodenpyl, Bailey, Tiffany, Hicks, Country Life Press.

Stephanotis floribunda Brongh. Tiffany.

ORDER VI. TUBIFLORAE (POLEMONIALES).

CONVOLVULACEAE.

Convolvulus aureus Hort. Golden Convolvulus. Tiffany.
Convolvulus japonicus Thunb. Small Rutland Beauty. Hicks.
Convolvulus sepium L. Rutland Beauty. C. S. H. vicinity.

POLEMONIACEAE.

Cobaea scandens Cav. "Cup and Saucer Plant." Pratt, C. S. H. vicinity.
Gilia capitata Dougl. Globe Gilia. Bailey.
Phlox amoena Sims. Amoena Phlox. Tiffany, DeForest, Hodenpyl, Hicks, Country Life Press.
Phlox Arendsii Hort. Havemeyer.
Phlox canadensis. Country Life Press. Var. *"Perry's"* Hort., *La Phaine* Hort. Country Life Press.
Phlox divaricata L. Blue Phlox. Matheson, DeForest, Hodenpyl, Hicks, Havemeyer.
Phlox Drummondii Hook. Drummond Phlox. Bailey, Pratt, Tiffany.
Phlox glaberrima var. *suffruticosa* Gray. Matheson, DeForest.
Phlox maculata L. (*P. decussata* Hort.) Sweet-William Phlox. Bailey, Tiffany, Willys, Hodenpyl.
Phlox ovata L. Country Life Press.
Phlox paniculata L. Summer Perennial Plox. Havemeyer, Pratt.
Phlox multiflora A. Nelson. Hodenpyl.
Phlox subulata L. Moss Phlox. Tiffany, Matheson, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt. Var. *alba* Hort., *"Daisy Hill"* Hort., *lilacina* Hort., *"vivid"* Hort., *"G. F. Wilson"* Hort., *setacea* Hort., Country Life Press.
Phlox horticultural varieties:
*Antonia Mercie.*_ DeForest Country Life Press.
Bacchante. DeForest.
Coquelicot. DeForest, Hodenpyl.
Elizabeth Campbell. Matheson, DeForest, Country Life Press.
Eugene Danzanvilliers. DeForest.
Frau Antoine Buckner. Country Life Press.

Fraulein von Lassburg. DeForest, Country Life Press.
Le Mahal. Country Life Press.
Miss Lingard Suf. Matheson, DeForest, Country Life Press.
Mme. Paul Dutrie. Matheson, DeForest, Country Life Press.
Mont Blanc, Suf. DeForest.
Pantheon. DeForest, Hodenpyl.
Rijanstroon—Country Life Press.
Thor. DeForest.

Polemonium caeruleum L. Greek Valerian. Matheson, DeForest, Hodenpyl, Hicks, Havemeyer, Pratt.

Polemonium humile Willd. Dwarf Polemonium. Hodenpyl.

Polemonium reptans L. Creeping Polemonium. Hodenpyl, Havemeyer.

BORRAGINACEAE.

Anchusa Barrelieri Vilm. Early Bugloss. Hodenpyl.

Anchusa italica Retz. (*A. azurea* Mill.) Italian Bugloss. DeForest, Willys, Tiffany, Bailey, Hicks, Havemeyer, Pratt. Var. "Dropmore Bugloss." Matheson, Bailey.

Anchusa myosotidiflora Lehm. Siberian Bugloss. DeForest, Havemeyer.

Echium vulgare L. Blue-Weed. Hodenpyl.

Heliotropium peruvianum L. Heliotrope. Bailey, Kahn.

Lithospermum canescens (Michx.) Lehm. Puccoon. Hodenpyl.

Mertensia ciliata Hort. Mountain Bluebells. Hodenpyl.

Mertensia virginica DC. Virginia Bluebells. Matheson, Hodenpyl, Havemeyer, Pratt.

Myosotis scorpioides L. Forget-Me-Not. DeForest, Havemeyer, Kahn, Hodenpyl, Hicks. Var: *semperflorens* Hort. (Dwarf Perpetual), Hodenpyl.

Myosotis sylvatica Hoffm. Woodland Forget-Me-Not. Var. *alpestris* Koch. Alpine Forget-Me-Not. Tiffany, DeForest, Bailey.

Omphalodes linifolia Moench. Hound's Tonque. Bailey, Matheson.

Omphalodes verna Moench. Venus button. DeForest, Hodenpyl.

VERBENACEAE.

Callicarpa americana L. var. *alba* Hort. White Beauty Berry. Bailey.

Callicarpa japonica Thunb. Japanese Beauty Berry. Bailey, Hodenpyl.

Callicarpa purpurea Juss. Chinese Beauty Berry. Bailey, Hodenpyl, Hicks.

Caryopteris incana Miq. Common Bluebeard. DeForest, Hodenpyl, Bailey, Hicks, Havemeyer, Pratt.

Clerodendrum speciosum Lem. Havemeyer.

Clerodendrum trichotomum Thunb. Harlequin Glorybower.

Lantana Camara L. Common Lantana. Kahn.

Lantana flava Hort. Yellow Lantana. Tiffany, Kahn.

Lantana involucrata L. DeForest.

Lippia citriodora HBK. Lemon Verbena. Bailey, Tiffany, Matheson, Kahn.

Vitex Negundo L. Negundo Chaste Tree. Bailey; var. *incisa* Clarke (Cutleaf Chaste Tree). Bailey.

LABIATAE.

Ajuga reptans L. Carpet Bugleweed. DeForest, Hodenpyl, Hicks, Pratt, Country Life Press. Var. *atropurpurea* Hort. Country Life Press.

Coleus Blumei Benth. Joseph's Coat. Border around Episcopal Church, C. S. H. Var. *Verschaffelti* Lem. Verschaffelt Coleus. Willys.

Elsholtzia Stauntoni Benth. Bailey, Hodenpyl.

Lavandula Spica L. Lavender. Pratt, Country Life Press.

Mentha citrata Ehrh. Bergamot Mint. C. S. H.

Mentha piperita L. Peppermint. Matheson.

Mentha rotundifolia Huds. Round-leaved Mint. C. S. H., near lakes.

Monarda didyma L. Oswego Tea. Matheson, DeForest, Hodenpyl, Hicks. Var. "Cambridge Scarlet," Country Life Press; var. *violacea superba* Hort. (Amaranth Bee Balm), *rosea* Hort. (Rose Bee Balm), *salmonea* Hort. (Salmon Bee Balm). Hodenpyl.

Nepeta Cataria L. Catnip. C. S. H., Pratt.

Nepeta hederacea Trev. Ground Ivy. Matheson, Hicks, Laboratory Grounds, C. S. H.

Nepeta Mussini Spreng. Bailey, Tiffany, Matheson, Kahn, DeForest, Havemeyer, Country Life Press.

Physostegia virginiana Benth. Virginia False Dragon Head. Matheson, Hodenpyl, Bailey, Hicks, DeForest, Pratt; var. *magnifica* Hort. Obedient plant. Country Life Press.

Prunella grandiflora Jacq. Great Selfheal. Hicks.

Salvia azurea Lam. Azure Salvia. Bailey, Tiffany, Matheson, Kahn, DeForest, Hicks, Pratt; var. *grandiflora* Benth. (Great Azures), Matheson, Hodenpyl.

Salvia farinacea Benth. Mealycup Sage. Bailey, Matheson, Kahn, Pratt.

Salvia leucantha Cav. Mexican Bush Sage. Matheson.

Salvia nemorosa Crantz. Blue or Violet Sage. Matheson, Country Life Press.

Salvia officinalis L. Garden Sage. Matheson.

Salvis patens Cav. Gentian Sage. Matheson, Kahn, Willys, Bailey.

Salvia pratensis L. Meadow Sage. DeForest, Hicks.

Salvia Sclarea L. Common Clary. Matheson; var. *turkestanica* Hort. Country Life Press.

Salvia splendens Ker. Scarlet Sage. Willys, Bailey.

Stachys grandiflora Benth. DeForest; var. *robusta* Hort. Betony. Bailey, DeForest.

Stachys lanata Jacq. Wooly Betony. Matheson, Kahn, Pratt.

Stachys officinalis Franch. Common Betony. DeForest.

Teucrium Chamaedrys L. Chamaedrys Germander. Bailey, DeForest, Hodenpyl.

Thymus Serpyllum L. Mother-of-Thyme. Pratt; var. *albus* Hort. White Wild Thymne; var. *coccinsus* Hort. Crimson Wild Thyme; var. *lanuginosus* Hort. Wooly Thyme; var. *citriodorus* Hort. Country Life Press.

Trichostema dichotomum L. Blue Curls. Hicks.

Thymus aphylla Hort. Country Life Press.

SOLANACEAE.

Datura Stramonium L. Jimson Weed. Carnegie Institution, C. S. H.

Lycium barbarum L. Barbary Matrimony Vine. Matheson, Willys, Bailey.

Lycium chinense Mill. Chinese Matrimony Vine. Hicks.

Lycium halimifolium Mill. Common Matrimony Vine. Bailey, Matheson.

Lycopersicon esculentum Mill. Tomato. Matheson. Var. *cerasiforme* Alef. Cherry Tomato. C. S. H. vicinity.

Nicotiana alata var. *affinis* Moore. Jasmine Tobacco. Bailey, Tiffany, Matheson.

Nicotiana Sanderae Sander. Pratt.

Nicotiana sylvestris Spegaz & Comes. Kahn, Pratt.

Nierembergia gracilis Hook. Slender Cutflower. Havemeyer.

Nierembergia rivularis Miers. White Cup. Country Life Press.

Petunia hybrida Vilm. Common Garden Petunia. Willys, Tiffany, Pratt, Matheson.

Physalis Alkekengi L. Strawberry Ground Cherry. DeForest.

Salpiglossis sinuata Ruiz & Pav. Pratt, Kahn.

Schizanthus retusus Hook. Butterfly flower. Laughlin Garden, Pratt.

Schizanthus wisetonensis Low. Wiseton Butterfly Flower. Tiffany, Pratt.

Solanum Capsicastrum Link. Var. *Melvini* Melvin. Jerusalem Cherry. Tiffany, Willys.

Solanum Melongena L. Common Eggplant. Tiffany, Willys.

Solanum Pseudocapsicum L. Jerusalem Cherry. Tiffany, Bailey, Pratt.

Solanum tuberosum L. Potato. C. S. H. vicinity.

SCROPHULARIACEAE.

Alonsoa Warscewiczi Regel. Heartleaf Maskflower. Bailey.

Antirrhinum majus L. Large Snap Dragon. C. S. H. cultivated.

Calceolaria frutico-hybrida Voss. (*C. integrifolia* L.) Calceolaria. Tiffany, Willys.

Castilleia coccinea (L.) Spreng. Indian Paint Brush. Hodenpyl.
Chelone glabra L. White Turtlehead. Hodenpyl.
Chelone Lyoni Pursh. Pink Turtlehead. Hodenpyl, Hicks.
Cymbalaria muralis Gaertn. Kenilworth Ivy.
Digitalis ambigua Murr. Yellow Foxglove. Pratt.
Digitalis lanata Ehrh. Grecian Foxglove. Pratt.
Digitalis purpurea Linn. Foxglove, Hodenpyl, Hicks, Pratt, DeForest. Var. *alba* Schrank (Common White Foxglove), Tiffany, Hodenpyl, Hicks, Bailey; var. *gloxiniaeflora* Hort. (Gloxinia Foxglove), Matheson, Hodenpyl.
Linaria cymbalaria Mills. Var. *alba* Hort. White Kenilworth Ivy. Willys.
Linaria macedonica Grib. Macedonian Toadflax. Havemeyer.
Linaria vulgaris Mill. Common Toadflax. Hodenpyl.
Mazus japonicus Kuntze. Havemeyer.
Nemesia strumosa Benth. Pounched Nemesia. Pratt.
Paulownia tomentosa Steud. Royal Paulownia. Bailey, Hicks, Havemeyer.
Pedicularis canadensis L. Early Wood Betony. Hodenpyl.
Penstemon alpinus Torr. Hodenpyl.
Pentstemon barbatus Roth. Bailey, Matheson, DeForest, Hodenpyl, Hicks, Pratt.
Pentstemon Cobaea Nutt. Cocaea Pentstemon. Hodenpyl.
Pentstemon gloxinoides Hort. Gloxinia Pentstemon. Willys, Matheson.
Pentstemon heterophyllus Lindl. Country Life Press.
Pentstemon hirsutus Willd. Eastern Pentstemon. Hodenpyl.
Pentstemon laevigatus Solander var. *digitalis* Gray. Foxglove Pentstemon. DeForest, Hodenpyl.
Pentstemon spectabilis Thurb. Showy Pentstemon. Hodenpyl.
Pentstemon Torreyi Benth. Torrey Pentstemon. Hicks, Pratt.
Rehmannia angulata Hemsl. DeForest.
Verbascum phoeniceun L. Purple Mullein. Hodenpyl.
Veronica gentianoides Vahl. Gentian Speedwell. Hodenpyl.
Veronica noveboracensis Hort. Hodenpyl.
Veronica incana L. Woolly Speedwell. Bailey, Hodenpyl, Havemeyer, Country Life Press.

Veronica longifolia L. Matheson, Hicks, Hodenpyl, DeForest, Bailey, Havemeyer, Pratt, Country Life Press; var. *subsessilis* Miq. Clump Speedwell. Matheson, DeForest, Hodenpyl, Hicks; var. *rosea* Hort. (Rosy Speedwell), Hodenpyl, Bailey.

Veronica repens DC. Creeping Speedwell. DeForest, Hicks, Bailey, Havemeyer, Pratt, Country Life Press.

Veronica spuria L. Bastard Speedwell. Matheson, Kahn, DeForest, Hicks.

Veronica Teucrium L. Hungarian Speedwell. DeForest; var. *prostrata* L., Havemeyer; var. *rupestris* Hort. (Rock Speedwell), Hodenpyl, Hicks, Havemeyer, Country Life Press.

BIGNONIACEAE.

Bignonia capreolata L. Cross Vine. Havemeyer.

Bignonia grandiflora Thunb. Chinese Trumpet Creeper. Matheson, Hodenpyl, Bailey.

Bignonia radicans L. Trumpet Creeper. Bailey, Hodenpyl, Tiffany, DeForest, Hicks.

Campsis radicans L. Seem. Trumpet Vine. Matheson.

Catalpa bignonioides Walt. Catalpa. Tiffany, DeForest, Hicks, Bailey, Pratt.

Catalpa Bungei C. A. May. Manchurian Catalpa. Willys, Hicks.

Catalpa speciosa Warder. Western Catalpa. Huntington Road, C. S. H., Matheson.

Incarvillea delavayi Bur. & Franch. DeForest.

GESNERIACEAE.

Naegelia zebrina Regel. Havemeyer.

Sinningia speciosa Benth & Hook. Common Gloxinia. Tiffany.

GLOBULARIACEAE.

Globularia trichosantha Fisch and Mey. Globe Daisy. Country Life Press.

Kolkwitzia ambilis Graebn. Hodenpyl, Hicks, Bailey.

ORDER VIII. RUBIALES.

RUBIACEAE.

Asperula odorata L. Sweet Woodruff. Matheson, DeForest.

Cephalanthus occidentalis L. Button Bush. Bailey, Hodenpyl, Matheson, Hicks.

Galium Mollugo L. Wild Madder. C. S. H., Huntington Road, Matheson.

Gardenia jasminoides Ellis var. *Fortuniana* Lindl. Veitch Cape Jasmine. Kahn.

Mitchella repens L. Partridgeberry. DeForest, Matheson, Hodenpyl, Hicks.

CAPRIFOLIACEAE.

Abelia chinensis R. Br. Chinese Abelia. Bailey.

Abelia grandiflora Rehd. Havemeyer, Hodenpyl, DeForest, Hicks.

Diervilla florida Sieb. & Zucc. Rose Weigela. Fish Hatchery Grounds, C. S. H., near entrance, Matheson, DeForest, Tiffany, Bailey; var. *venusta* Hort. Hodenpyl.

Diervilla floribunda C. Moy. Crimson Weigela. Havemeyer.

Diervilla Lonicera Mill. Dwarf Bush Honeysuckle. Bailey, Hodenpyl.

Diervilla praecox Le Moine. Early weigela. Hodenpyl.

Linnaea borealis L. Twin Flower. Hodenpyl.

Lonicera amoena Zabel var. *Gotha* Hort. Hodenpyl; var. *arnoldiana* Hort. Hodenpyl.

Lonicera bella Zabel. Bell honeysuckle. Hodenpyl.

Lonicera caerula L. Sweetberry Honeysuckle. Bailey, Hodenpyl.

Lonicera chamisosi Hort. Hodenpyl.

Lonicera ciliosa Poir (L. *occidentalis* Hook), Hodenpyl.

Lonicera fragrantissima Lindl. Winter Honeysuckle. Hodenpyl, DeForest, Hicks.

Lonicera giraldi Hort. Girald Honeysuckle. Hodenpyl.

Lonicera gracilipes Mig. Spangle Honeysuckle. Hodenpyl, Bailey.

Lonicera Heckrottii Rehd. Everblooming Honeysuckle. Bailey, Hodenpyl.

Lonicera Henryi Hemsl. Henry Honeysuckle. Hicks, Hodenpyl, Bailey.

Lonicera involucrata Banks. Bearberry Honeysuckle. Hodenpyl, Bailey; var. *serotina* Hort. Hodenpyl.

Lonicera japonica Thunb. Japanese Honeysuckle. Havemeyer, Pratt; var. *Halliana* Arb. Kew., Willys, Kahn Hodenpyl, Tiffany, Bailey.

Lonicera Korolkovi Stapf. Blue Leaf Honeysuckle. Hodenpyl, Bailey.

Lonicera Ledebouri Eschsch. Hodenpyl.

Lonicera Maacki Maxim. Havemeyer. Var. *podocarpa* Hort. Late Honeysuckle. Hicks, Hodenpyl.

Lonicera microphylla Willd. Hodenpyl.

Lonicera minutiflora Zabel. Bunchberry Honeysuckle. Hodenpyl.

Lonicera Morrowi Gray. Morrow Honeysuckle. DeForest, Hodenpyl, Hicks, Bailey, Havemeyer.

Lonicera muscanviensis Moscow Honeysuckle. Hodenpyl.

Lonicera nitida Wils. Havemeyer, Hodenpyl, Pratt.

Lonicera oblongifolia Hook. Swamp Fly Honeysuckle. Hodenpyl.

Lonicera pileata Oliver. Privet Honeysuckle. Hodenpyl, Bailey, Havemeyer.

Lonicera prostrata Hort. Creeping Honeysuckle. Hodenpyl, Havemeyer.

Lonicera Ruprechtiana Regel. Manchurian Honeysuckle. Hicks.

Lonicera sempervirens L. Trumpet Honeysuckle. Hodenpyl, Hicks.

Lonicera similis Hemsl. Hodenpyl.

Lonicera spinosa Jacquemont. Thorn Honeysuckle. Hodenpyl.

Lonicera Standishii Carr. Standish Honeysuckle. Hicks.

Lonicera syringantha Maxim. Lilac Honeysuckle. Hicks, Bailey, Hodenpyl; var. *Wolfi* Rehd. (Wolf Honeysuckle), Bailey, Hodenpyl.

Lonicera tangutica Max. Blush Honeysuckle. Bailey, Hodenpyl.

Lonicera tatarica L. Tartarian Honeysuckle. Bailey, Havemeyer, Tiffany, Laboratory grounds, C. S. H., Matheson, DeForest, Hodenpyl, Hicks; var. *alba* Hort. (White Tatarian), Hodenpyl; var. *rosea* Hort. (Red Tatarian), Hodenpyl; var. *grandiflora* Rehd. (Bride H.), Hodenpyl; var. *tubriflora* DC.. (*sibirica* Hort.), Hodenpyl.

Lonicera thibetica Bureau and Franch. Tibetan Honeysuckle. Hodenpyl.

Lonicera xylosteoides Hort. Vienna Honeysuckle. Bailey.

Sambucus callicarpa Hort. Hodenpyl.

Sambucus canadensis L. American Elder. Tiffany, Pratt, Bailey, Matheson, DeForest, Hodenpyl, Hicks; var. *aurea* Hort. Tiffany, Bailey; var. *acutiloba* Hort. Cutleaf American Elder. Hodenpyl; var. *chlorocarpa* Hort. Greenberry Elder. Hodenpyl.

Sambucus nigra L. European Elder. Havemeyer.

Sambucus pubens Michx. Scarlet Elder. Bailey, Hodenpyl.

Sambucus racemosa L. European Red Elder. Hodenpyl.

Symphoricarpos mollis Gray (*S. acutus* Dipp.) Spreading Snowberry. Havemeyer.

Symphoricarpos oreophilus Gray. Mountain Snowberry. Hodenpyl.

Symphoricarpos racemosus Michx. (S. *albus* Blake) Common Snowberry. DeForest, Hodenpyl, Hicks, Bailey.

Symphoricarpos vulgaris Michx. (*S. orbiculatus* Moench). Coralberry. Bailey, Matheson, Hodenpyl, Hicks.

Viburnum acerifolium L. Dockmackie. Jones Woods, C. S. H., Bailey, DeForest, Hodenpyl, Havemeyer, Pratt.

Viburnum americanum Auth. (*V. trilobum* Marsh). American Cranberrybush. Bailey, Hicks.

Viburnum burejaeticum Herd. and Regel. Manchurian Viburnum. Hodenpyl.

Viburnum Carlesii Hemsl. Fragrant-Viburnum. Bailey, DeForest, Hodenpyl, Hicks, Havemeyer.

Viburnum cassinoides L. Withe-Rod. DeForest, Hodenpyl, Hicks, Havemeyer.

Viburnum Davidii Hort. Hodenpyl.

Viburnum dentatum L. Arrow-Wood. Bailey, Tiffany, C. S. H., DeForest, Hodenpyl, Hicks, Havemeyer.

Viburnum dilatatum Thunb. Linden Virburnum. Bailey, Matheson, DeForest, Hodenpyl, Havemeyer, Country Life Press.

Viburnum erubascens Hort. Hodenpyl.

Viburnum ichogense Hort. Hodenpyl.

Viburnum japonicum Spreng. Japanese Viburnum. DeForest.

Viburnum Latana L. Wayfaring Tree. Bailey, DeForest, Tiffany, Hodenpyl, Hicks, Havemeyer, Pratt; var. *rugosum* Hort. Wrinkleleaf Wayfaring Tree. Hodenpyl.

Viburnum Lentago L. Sheep Berry. Hodenpyl, DeForest, Bailey, Hicks, Havemeyer, Pratt.

Viburnum macrocephàlum Fortune. Chinese Viburnum. Havemeyer.

Viburnum molle Michx. Kentucky Viburnum. Bailey, DeForest, Hodenpyl.

Viburnum nepalense Hort. Hodenpyl.

Viburnum nudum L. Smooth Withe-Rod. Bailey, Hodenpyl, Havemeyer; var. *angustifolium* Torr. and Gray.

Viburnum odoratissimum Ker. Sweet Viburnum. DeForest.

Viburnum Opulus L. European Cranberrybush. DeForest, Hodenpyl, Tiffany, Hicks, Bailey; var. *sterile* DC. Matheson, Hodenpyl; var. *xanthocarpum* Yellow Fruit Cranberry. Hodenpyl.

Uiburnum prunifolium L. Black Haw. Bailey, DeForest, Hodenpyl.

Viburnum pubescens Pursh. Hodenpyl; var. *affine* (Missouri Viburnum), Hicks.

Viburnum rhytidophyllum Hemsl. Leatherleaf Viburnum. Bailey, Hicks, DeForest, Hodenpyl, Country Life Press.

Viburnum Sargentii Koehne. Sargent Cranberrybush. Hodenpyl.

Viburnum Sieboldi Miq. Siebold Viburnum. Matheson, DeForest, Hodenpyl, Havemeyer.

Viburnum Tinus L. Laurestinus. Pratt.

Viburnum tomentosum Thunb. Double File Viburnum. DeForest, Hodenpyl, Hicks, Havemeyer; var. *plicatum* Max. Bailey, Matheson, DeForest, Hodenpyl, Willys.
Viburnum utile Hemls. Service Viburnum. Havemeyer.
Viburnum venosum Britt. Var. *Canbyi* Rehd. Canby Viburnum. Hicks.
Viburnum Wrighti Mig. Wright Viburnum. Hodenpyl, Hicks, Bailey.

VALERIANACEAE.

Centranthus macrosiphon Boiss. Spur Valerian. Matheson.
Centranthus ruber DC. Jupiters beard, Red Valerian. DeForest, Hodenpyl, Country Life Press.
Valeriana acutiloba Hort. Hodenpyl.
Valeriana officinalis L. Common Valerian. Matheson, DeForest, Hodenpyl, Hicks, Pratt; var. *alba* Hort., DeForest, Hodenpyl.

DIPSACACEAE.

Scabiosa caucasia Bieb. Caucasian Scabiosa. DeForest, Hodenpyl, Tiffany, Bailey, Havemeyer, Pratt.
Scabiosa japonica Miq. Mourning Bride. Bailey, Pratt.

ORDER IX. CUCURBITALES (CAMPANULALES).

CUCURBITACEAE.

Cucumis sativus L. Cucumber. Matheson.
Cucumis verrucosus Duchesne. Crooked Necked Squash. In cultivation, C. S. H.
Cucurbita moschata Duchesne. Winter Crookneck Squash. C. S. H.
Cucurbita Pepo L. Pumpkin. Gardens, C. S. H.

ORDER X. CAMPANULATAE (CAMPANULALES).

CAMPANULACEAE.

Adenophora Potanini Korsh. Bush Ladybell. Havemeyer.
Campanula carpatica Jacq. Carpathian Bell Flower. Bailey, Hodenpyl, Tiffany, DeForest, Kahn, Hicks, Havemeyer,

Country Life Press. Var. *alba* Hort. White Carpathian Harebell. Country Life Press.

Campanula garganica Ten. Havemeyer.

Campanula glomerata L. Danes blood. Bailey, DeForest, Havemeyer.

Campanula Grosseki Heuff. Grossek Bellflower. DeForest, Bailey.

Campanula lactiflora Bieb. Milky Bell Flower. Havemeyer; var. *alba grandiflora* Hort. White Tall Bell Flower. Country Life Press; var. *"E. Molyneaux."* Country Life Press.

Campanula latifolia L. Great Bell Flower. Havemeyer.

Campanula latiloba A. DC. Olympic Bell Flower. Hodenpyl, Bailey.

Campanula macrostyla Boiss & Heldr. Anatolian Bell Flower. Havemeyer.

Campanula medium L. Canterbury Bells. Bailey, Matheson, Willys, DeForest, Hicks, Pratt. Var. *calycanthema* Hort. Cup-and-Saucer Bell Flower. Bailey, Willys.

Campanula persicifolia L. Peach Leaf Bell Flower. Matheson, Bailey, Hodenpyl, DeForest, Kahn, Tiffany, Hicks, Havemeyer, Pratt. Var. *Moerheimi* Hort. Double white peach leaved Bell Flower. DeForest, Hodenpyl, Country Life Press; var. *"Fairy Bell Flower."* Matheson; *"Telham Beauty."* Country Life Press.

Campanula punctata Lam. Spotted Bell Flower. DeForest. Var. *"Marian Gehring."* Country Life Press.

Campanula pyramidalis L. Chimney Bell Flower. Bailey, Hodenpyl, Tiffany, DeForest, Hicks, Havemeyer, Pratt.

Campanula rapunculoides L. False Rampion. C. S. H. vicinity. Hodenpyl, Hicks.

Campanula rotundifolia L. Harebell. Matheson, DeForest, Hodenpyl, Pratt.

Campanula Trachelium L. Coventry Bells. Havemeyer.

Platycodon grandiflorum A. DC. Balloon Flower. Kahn, Tiffany, Pratt, DeForest, Hodenpyl, Matheson, Bailey, Hicks, Havemeyer, Country Life Press; var. *Mariesii* Nicholls. Country Life Press.

LOBELIACEAE.

Lobelia cardinalis L. Cardinal Flower. DeForest, Hodenpyl, Hicks, Bailey.

Lobelia Erinus L. Edging Lobelia. Tiffany, DeForest; var. *pumila* (Blue Dwarf Lobelia), Kahn.

Lobelia gracilis Andr. Slender Lobelia. Willys.

Lobelia syphilitica L. Large Blue Lobelia. Hodenpyl.

COMPOSITAE.

Achillea Ageratum L. Sweet Yarrow. Pratt.

Achillea filipendulina Lam. Fernleaf Yarrow. Hicks.

Achillea tenutosa Hort. Hodenpyl.

Achillea Millefolium L. Yarrow. Laboratory grounds, C. S. H., Matheson, DeForest, Hodenpyl, Hicks; var. *rosea* Hort. Pink Yarrow. Matheson.

Achillea Ptarmica L. Sneezewort. Matheson, DeForest, Hodenpyl, Hicks, Country Life Press; var. *Boule de Neige* Hort.; var. *Pearl* Hort.; var. *Perry White* Hort. Matheson.

Achillea tomentosa L. Woolly Yarrow. Matheson, Hicks, Country Life Press.

Ageratum Houstonianum Mill. Hodenpyl; var. *nanum* Hort. Bailey.

Ageratum latifolium Hort. Little Bluestar Ageratum. Kahn.

Ageratum sp. Willys.

Anthemis tinctoria L. Yellow Camomile. Havemeyer, DeForest, Hodenpyl, Bailey, Tiffany, Hicks, Matheson, Pratt; var. *Kelwayi* Hort. Kelway Camomile. Hodenpyl, DeForest, Bailey.

Arctotis grandis Thunb. (*A. stoechadifolia* Barg.) Bushy Arctotis. DeForest, Bailey, Tiffany, Hicks, Havemeyer.

Artemisia Dracunculus L. Tarragon. Matheson, Bailey.

Artemisia Abrotanum L. Southernwood. Bailey, Hicks, Kahn, Matheson.

Artemisia lactiflora Wall. Hawthorn scented Mugwort. Country Life Press.

Artemisia pontica L. Roman Wormwood. Havemeyer.

Artemisia sacrorum Ledeb. var. *viridis* Hort. Summer Fir. Matheson.

Artemisia Stelleriana Bess. Dusty Miller. Matheson, Sand Spit, C. S. H., Kahn.

Artemisia vulgaris L. var. *lactiflora* Wall. White Mugwort. Matheson, Kahn, DeForest, Bailey, Havemeyer, Pratt.

Aster acuminatus Michx. Hodenpyl.

Aster alpinus L. Rock Aster. Bailey, DeForest, Hicks, Havemeyer, Pratt. Vars: *Climax,* DeForest, Hodenpyl; *Feltham Blue,* Hodenpyl; *Glory of Colwell,* DeForest; *Lil Fardell,* DeForest, Hodenpyl; *Mauve Cushion,* Hodenpyl; *Peggy Ballard,* Hodenpyl; *Robert Parker,* Hodenpyl; *Snow Flake,* Hodenpyl; *St. Egwin,* DeForest, Hodenpyl; *The Queen,* Hodenpyl; *Top Sawyer,* Hodenpyl.

Aster Amellus L. Pratt.

Aster azureus Lindl. Azure Aster. Bailey, Hodenpyl.

Aster chapmani Hort. Savannah Aster. DeForest.

Aster cordifolius L. Blue Wood Aster. Bailey, Hodenpyl, Tiffany.

Aster corymbosus Ait.? White Wood Aster. Bailey, Hodenpyl.

Aster ericoides L. Hodenpyl.

Aster laevis L. Smooth Aster. Bailey, Hodenpyl, DeForest.

Aster linariifolius L. Hodenpyl.

Aster longifolius Longleaf Aaster. Hodenpyl.

Aster macrophyllus L. Bigleaf Aster. Hodenpyl.

Aster multiflorus Ait. Wreath Aster. Hodenpyl.

Aster novae-angliae L. New England Aster. Bailey, Hodenpyl, Matheson, DeForest, Hicks, Pratt; var. *roseus* (Desf.) DC. Rosy N. England Aster. Bailey, Hicks.

Aster novi-belgii L. New York Aster. Bailey, DeForest, C. S. H.

Aster patens Ait. Skydrop Aster. Matheson.

Aster Prenanthides Muhl. Hodenpyl.

Aster subcaeruleus S. Moore. India Aster. DeForest, Hodenpyl, Bailey, Havemeyer.

Aster tataricus L. f. Tatarian Aster. Matheson, DeForest, Bailey, Hicks, Kahn, Havemeyer.

Aster Tradescantii L. Michaelmas Daisy. Hodenpyl, Bailey.
Aster turbinellus Lindl. Prairie Aster. DeForest.
Aster umbellatus Mill. Flat Top Aster. Hodenpyl.
Aster undulatus L. Ware Aster. Hodenpyl.
Aster vars. Climax (Pale Blue Michaelmas Daisy), DeForest, Hodenpyl; *Feltham Blue* (Deep Blue Michaelmas Daisy), Hodenpyl; *Glory of Colwell* (Double Blue Michaelmas Daisy), DeForest; *Gaggie Perry* (Mauve Michaelmas Daisy), Hodenpyl; *Mrs. Walkerdine* (Pale Blue Michaelmas Daisy), Hodenpyl; *Belgian Queen, Blue Beard, Blue Gem, Blushing Bride, Brightest and Best, Captain Fryatt, Desire.* Hodenpyl.
Baccharis halimifolia L. Groundselbush. Bailey, Hodenpyl, Matheson, DeForest.
Bellis perennis L. English Daisy. Bailey, Hodenpyl, Tiffany, C. S. H., Matheson, DeForest, Hicks.
Boltonia asteroides L'Her. Boltonia (White). Bailey, Hodenpyl, Matheson, DeForest, Hicks, Havemeyer.
Boltonia latisquama Gray. Violet Boltonia. Bailey, Hodenpyl, Matheson, DeForest. Var. *nana* Hort. Dwarf False Starwort. Country Life Press.
Brachycome iberidifolia Benth. Swan River Daisy. Bailey.
Calendula officinalis L. Calendula. Kahn, Willys, Tiffany, Matheson, Bailey, Pratt.
Centaurea americana Nutt. Basket Flower. Pratt.
Centaurea Cineraria L. Dusty Miller. Tiffany, Matheson, Bailey.
Centaurea Cyanus L. Cornflower. Havemeyer, Tiffany, Matheson, Bailey.
Centaurea montana L. Mountain Bluet. Bailey, Matheson, DeForest, Hodenpyl, Willys, Hicks.
Centaurea nigra L. Knapweed. C. S. H. near lakes.
Cichorium Intybus L. Chicory. Laboratory grounds, C. S. H.
Chrysanthemum arcticum L. Arctic Chrysanthemum. Matheson.
Chrysanthemum coccineum Willd. Painted Lady. Bailey, Tiffany, Matheson, DeForest, Hodenpyl.

Chrysanthemum Leucanthemum L. Ox-Eye-Daisy. Laboratory grounds, C. S. H., Matheson.

Chrysanthemum maximum Raymond. Shasta Daisy. Pratt, Country Life Press.

Chrysanthemum Parthenium Pers. Feverfew. Matheson, Tiffany.

Chrysanthemum uliginosum Pers. Giant Daisy. Matheson, DeForest, Hodenpyl.

Chrysanthemum—horticultural varieties:

Bertha Fairs. Willys.
Black Hawk. Tiffany.
Bob Pulling. Tiffany, Kahn.
Bronze Buckingham. Matheson, Kahn.
Bronze Doty. Kahn.
Bronze Molly. Tiffany, DeForest.
Bronze Source d'Or. Kahn.
Bronze Turner. Willys.
Bronze Bessie. Tiffany.
Charles H. Totty. Tiffany.
Chrysolora. Tiffany.
Colonel Appleton. Tiffany.
Corporal J. Fred Piper. Willys.
Dainty. Tiffany.
Dolly Duncan. Tiffany.
Dr. Enguehard. Tiffany.
Early Frost. Kahn.
Excelsior. Willys.
Glorianna. Willys.
Godfreys Perfection. Kahn.
Golden Glow. Tiffany.
Harvard. Tiffany.
James Fraser. Kahn.
Jeanne Nonin. Tiffany.
Klondike. Tiffany.
Lillian Doty. Tiffany, Kahn.
Louis Spears. Willys.
Louisa Pockett. Willys, Tiffany.
Majestic. Willys.
Mary. Kahn.
Mensa. Tiffany, Willys.
Meudon Surprise. Kahn.
Miss Clay Frick. Tiffany.

Miss Isabelle. Willys.
Molly Hunt. Willys.
Mrs. C. S. McKinney. Tiffany.
Mrs. E. D. Godfrey. Tiffany, Kahn.
President John Everitt. Kahn.
Rose Day. Willys.
Sergeant Wm. E. Young. Kahn.
Thanksgiving Queen. Tiffany.
Vermont. Willys.
Wee Wah. Tiffany.
Wells Late Pink. Tiffany.
White Doty. Kahn.
White Helen Frick. Tiffany.
W. H. Lincoln. Tiffany.
William H. White. Willys, Tiffany, Kahn.
William Rigby. Kahn.
William Turner. Willys, Tiffany, Kahn.
Yellow Turner. Tiffany, Kahn.

Coreopsis grandiflora Nutt. Big Coreopsis, Tick Seed. Tiffany, DeForest, Country Life Press.

Coreopsis lanceolata L. Lance Coreopsis. Tiffany, Willys, Matheson, DeForest, Hodenpyl, Hicks.

Coreopsis rosea Nutt. Rose Coreopsis. Hodenpyl.

Coreopsis tinctoria Nutt. Garden Tickseed. Davenport's Garden and elsewhere at C. S. H. in gardens.

Cosmos bipinnatus Cay. Common Cosmos. Tiffany.

Dahlia imperialis Roezl. Candelabra Dahlia. Matheson.

Dahlia pinnata Cav. C. S. H.

Dahlia—horticultural varieties:

Attraction. Willys.
Bianca. Matheson.
Break o' Day. Matheson.
C. E. Wilkins. Matheson.
Clara Seaton. Matheson.
Colossal Palace. Matheson.
Diana. Matheson.
Dorothy Peacock. Matheson.
Dr. Roy Appleton. Matheson.
Dr. Trevis. Willys.
Elsa. Matheson.
Etendard de Lyon. Matheson.

Excelsior. Matheson.
Fiet. Matheson.
Florence. Stredwick. Matheson.
Forest Loma. Matheson.
Futurity. Matheson.
F. W. Fellowes. Matheson.
General Miles. Matheson.
Glory of New Haren. Matheson.
Goethe. Matheson.
Harvest Moon. Matheson.
Jack Rose. Willys.
J. B. Riding. Matheson.
Jean Wood. Matheson.
Jessie Seal. Matheson.
John Riding. Matheson.
Jonkheer Borsel. Matheson.
Judge Marean. Matheson.
La Favorita. Matheson.
Lady Helen. Matheson.
Lady Thornton. Matheson.
LeGrand Manitou. Matheson.
Magnificent. Matheson.
Maid of Mist. Willys.
Marjorie Hillbank. Matheson.
Mars. Matheson.
May Matheson. Matheson.
Mephistopheles. Willys.
Mrs. Carl Salbach. Matheson.
Mrs. C. G. Breck. Matheson.
Mrs. E. C. Boston. Matheson.
Mrs. Edna Spencer. Matheson.
Mrs. Estes. Matheson.
Mrs. Ethel F. T. Smith, Matheson.
Mrs. F. C. Burns. Matheson.
Mrs. Ferdinand Jeffries. Matheson.
Mrs. I. deVer Warner. Matheson.
Mrs. Roosevelt. Matheson.
Mrs. Salbach. Matheson.
Mrs. Stevenson. Matheson.
Mrs. Stredwick. Matheson.
Merthus. Matheson.
Papa Charmer. Matheson.
Patrick O'Mara. Matheson.
Pierrot. Matheson.

Pride of California. Willys.
Prima Donna. Matheson.
Queen Esther. Matheson.
Rawson. Matheson.
Rosa Nell. Matheson.
Sagamore. Matheson.
Walter Jennings. Matheson.

Dimorphotheca annua Less. Double Cape Marigold. Bailey.

Dimorphotheca aurantiaca DC. Cape Marigold. Pratt, C. S. H. vicinity.

Doronicum caucasium Bieb. Caucasian Leopard Bane. DeForest, Hicks.

Echinacea angustifolia DC. Hodenpyl.

Echinacea pallida Hort. Hodenpyl.

Echinaea purpurea Moench. Tiffany, DeForest, Bailey, Hicks.

Echinops Ritro L. Steel Globethistle. Tiffany, Matheson, Havemeyer, Pratt, Conutry Life Press.

Erigeron alpinus Alpine Fleabane. Bailey.

Erigeron glabellus Nutt. Smooth Fleabane. Havemeyer.

Erigeron speciosus DC. Oregon Fleabane. Hodenpyl, Havemeyer; var. *grandiflorus* Hort. (Purple Oregon Fleabane), Hodenpyl; var. *superba* Hort., Country Life Press.

Eupatorium coelestinum L. Mist Flower. Matheson, DeForest, Hodenpyl, Tiffany, Hicks, Havemeyer.

Eupatorium purpureum L. Joe Pye Weed. Tiffany, Hodenpyl, Matheson.

Eupatorium urticaefolium Reichard. Snow Thoroughwort. Matheson, DeForest, Hodenpyl.

Gaillardia aristata Pursh. Common Perrennial Gaillardia. Bailey, Tiffany, Matheson, Hodenpyl, Hicks, Pratt.

Helenium autumnale L. Common Sneezeweed. Havemeyer, Matheson, DeForest, Hodenpyl, Hicks, Bailey; var. *superbum* Hort. (Red Sneezeweed), Kahn, Hodenpyl; *"Riverton Beauty,* Country Life Press; *"Riverton Gem,"* Country Life Press; var. *pumilum* Hort., Country Life Press.

Helenium Hoopesi Gray. Orange Sneezeweed. Hodenpyl, Havemeyer.

Helianthella quinquenervis Gray. Hodenpyl.
Helianthus annuus L. Sunflower, C. S. H. Var. *nanus* fl. pl. (Double Dwarf Sunflower), Matheson; var. *coronatus* Hort. Red Sun Flower. C. S. H. vicinity.
Helianthus debilis Nutt. Cucumber Leaved Sunflower. Bailey, C. S. H.
Helianthus decapetalus L. Thinleaf Sunflower. Hodenpyl.
Helianthus giganteus L. Indian Potato. Matheson, Hodenpyl.
Helianthus grosse-serratus Martens. Sawtooth Sunflower. Hodenpyl.
Helianthus laetiflorus Pers. Showy Sunflower. Matheson.
Helianthus Maximiliani Schrad. Maximilian Sunflower. Tiffany, Matheson, DeForest.
Helianthus mollis Lam. Ashy Sunflower. Hempstead Plain. DeForest, Hodenpyl.
Helianthus orgyalis DC. Hicks.
Helianthus tuberosus L. Jerusalem Artichoke. Tiffany, Hodenpyl, Bailey.
Helichrysum bracteatum Andr. Strawflower. Tiffany, Bailey.
Heliopsis helianthoides Sweet. Var. *pitcheriana* Hort. Pitcher Heliopsis. Matheson.
Hieracium aurantiacum L. Orange Hawkweed. Laboratory grounds, C. S. H.
Inula montana L. Mountain Inula. Havemeyer.
Leontopodium alpinum Cass. Common Edelweiss. DeForest.
Lepachys pinnata (Vent) T. & G. DeForest.
Liatris punctata Hook. Dotted Gay Feather. Hicks.
Liatris pycnostachya Michx. Kansas Gay Feather. Country Life Press.
Liatris spicata (L.) Willd. Spike Gay Feather. DeForest, Hodenpyl, Hicks, Bailey.
Liatris squarrosa Willd. Hodenpyl.
Petasites fragrans Presl. Sweet Butternut. Hodenpyl.
Petasites Japonica F. W. Schmidt. Japanese Butterbur. Hodenpyl.
Pyrethrum uliginosum Hort. Moon Daisy. Country Life Press.
Rudbeckia californica Hort. California Coneflower. Hodenpyl.

Rudbeckia hirta L. Black-Eyed Susan. Hodenpyl, Bailey, Tiffany, Matheson, Hicks.
Rudbeckia laciniata L. Matheson. Var. "Goldenglow," Bailey, Tiffany, Willys, Matheson.
Rudbeckia speciosa Wenderoth. Black-Eyed Susan. Country Life Press.
Rudbeckia triloba L. Matheson.
Santolina Chamaecyparissus L. Lavender Cotton. Matheson, Kahn, Bailey, Havemeyer, Country Life Press.
Senecio Cineraria DC. Matheson.
Senecio cruentus DC. Bailey, Tiffany, Willys.
Senecio pulcher Hook and Arn. Uruguay Groundsel. Hodenpyl.
Silphium perfoliatum L. Cup Rosinwood. DeForest.
Solidago bicolor L. White Goldenrod. Hodenpyl.
Solidago Boottii Hook. Boott Goldenrod. Hodenpyl.
Solidago canadensis L. Canada Goldenrod. Hodenpyl.
Solidago erecta Pursh. Scepter Goldenrod. Hodenpyl.
Solidago glomerata Hort. Cluster Goldenrod. Tiffany, DeForest, Hodenpyl.
Solidago juncea Ait. Hodenpyl.
Solidago nemoralis Ait. Oldfield Goldenrod. Hodenpyl.
Solidago ohioensis Riddell. Hodenpyl.
Solidago patula Muhl. Roughleaf Goldenrod. Hodenpyl.
Solidago pubens Furry Goldenrod. Hodenpyl.
Solidago rigida L. Stiff Goldenrod. Hodenpyl.
Solidago rugosa Mill. Wrinkled Goldenrod. Hodenpyl.
Solidago sempervirens L. Seaside Goldenrod. Willys, DeForest.
Stokesia laevis Greene. Stokes Aster. Matheson, Hicks, DeForest, Hodenpyl, Pratt; var. *alba* Hort. (White Stokesia), DeForest, Hodenpyl, Bailey.
Stokesia palmata Hort. Hodenpyl.
Stokesia ulmariaflora Hort. Hodenpyl.
Tagetes erecta L. Aztec Marigold. Tiffany, Kahn.
Tagetes patula L. French Marigold. Willys.
Townsendia exscapa Porter. Hodenpyl.
Zinnia elegans Jacq. Youth and Old Age. Pratt, Bailey, Tiffany, Hodenpyl.

PROFESSOR JACOB BOLL AND THE NATURAL HISTORY OF THE SOUTHWEST

S. W. GEISER
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PROFESSOR JACOB BOLL

I.

In his brochure entitled, *The Botany of Texas,* Winkler[1] has done a conspicuous service in preserving to present-day workers the personalities and achievements of earlier students of the flora of the Southwest. It is a curious fact that while the museums of America and Europe are full of specimens collected in Texas by numbers of gifted collectors, one nevertheless often searches in vain for notes regarding the lives of the collectors themselves. Lindheimer, the "Father of Texas Botany" who died in 1879 after nearly a half-century of pioneer work (in which he collaborated with Asa Gray and Dr. George Engelmann) waited until 1907 for an adequate biographical sketch to appear.[2] The names of other naturalists and collectors in the Southwest, such as H. P. Attwater, R. Menger, J. A. Singley, G. W. Belfrage, Julien Reverchon, Howard Lacey, Rev. G. Birkmann, Charles D. Oldright, and Jacob Boll (to all of whom we are indebted for highly valuable field-observations and collections) are merely names, and little or no account is preserved of their lives and work.

It is with this in mind, and with the desire to record the chief events in the life of one of the most accomplished of these earlier naturalist-collectors that the present writer offers this sketch of the life of Jacob Boll and his influence on the natural history of the Southwest. It has not been an easy task to gather the broken threads of an almost for-

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[1] WINKLER, C. H. *The Botany of Texas, an Account of Botanical Investigations in Texas and Adjoining Territory.* Bull. Univ. Texas, 1915, no. 18, 1915.

[2] Biography in J. W. BLANKENSHIP: *Plantae Lindheimerianae, Part III.* Ann. Rept. Missouri Bot. Garden, vol. 18, pp. 119-233, 1907.

gotten narrative. Jacob Boll died in 1880, nearly fifty years ago. While he has left descendants in the city of Dallas, he was of so singularly modest and retiring a disposition that Dr. Robert T. Hill[3], writing of him only seven years after his death, was unable to gather any details of his life and personality. Like Lindheimer, Boll never spoke of his special interests. In a frontier country, with few associates that could appreciate his work, he worked in silence, motivated only by his inner light. Another factor beside his modesty that contributed to his inarticulateness was the language-difficulty. But two English papers appeared from his pen (outside of newspaper articles), and these two appeared within a year of his death. Hill *(l. c.)* has said of these that they "were only the introduction to what promised to be valuable original contributions to the geology of Texas." The combined result of his early death and his unusual reticence is the fact that his part in the scientific development of Texas has been forgotten, if, indeed, it ever was adequately known. The following appear to be the facts of his life:

Jacob Boll was born the son of Henry and Magdalena (Peier) Boll, at Bremgarten, Canton Aargau, Switzerland, on May 29, 1828. He was the eldest of five children. His parents were fairly well-to-do and enabled him, after a *Gymnasium* career in Switzerland, to attend for two years the University of Jena, where he studied chemistry, natural history, and pharmacy. He left the university in 1853 without a degree, returned to his native town where he became an apothecary in his own pharmacy, married Henriette Humbel of Bremgarten, and settled down. During their twenty years of married life, three children were born. The pharmacy (which he had bought with his wife's dowry) did not prosper, for Jacob Boll was too much interested in natural history to devote very much of his at-

[3] HILL, R. T. *The Present Condition of Knowledge of the Geology of Texas.* Bull. no. 45, U. S. Geological Survey, 1887.

tention to the conduct of the business. In 1869 he sold out the pharmacy, thinking to recoup his losses in America, especially in Texas, where early German colonization had effected a strong German element in the population. Then, too, his brother Henry had come to *La Réunion*, near Dallas, (where Victor Considerant had founded a communistic colony on the phalansterian ideas of Fourierism) and the later arrival of his parents and other kin made Texas a new home for Jacob Boll.

During the seventeen years spent in the Bremgarten pharmacy Boll had continually collected the plants and animals of his Canton. His botanical studies bore fruit in a thin duodecimo of 127 pages on the flora of Bremgarten, published during the late summer of 1869.[4] During this period (1853-1869) Boll for some time served as Professor of Natural History in the college at Bremgarten, and was elected to membership in a number of scientific societies in Switzerland and Germany, being even elected to honorary membership in the *Academia Caesaraea Leopoldiana* of Germany, (according to Mr. John Henry Brown, the historian of the Southwest, who then lived at Dallas.) For years he made annual and semi-annual explorations of the Alps. "He won a wide reputation by his researches and published essays. He was also appointed by the government examiner of physicians and pharmacists, and also held the government seal in the departments of zoology and natural history . . . He was a collaborator on the Geological Map of Switzerland."[5]

Professor Boll arrived in America late in 1869. On his way to Texas he stopped off at Cambridge to visit his com-

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[4] BOLL, J. *Verzeichniss der Phanerogamen-und Kryptogamen-Flora von Bremgarten, dem untern Freiamt, Hallwilersee, Limmathal und den angrenzenden Theilen des Kantons Zurich.* Aarau, Druck & Verlag von J. J. Christen, 1869. viii+127 pp. (Copy in Beilharz Collection.)

[5] BROWN, J. H. *Memoir of the late Professor Jacob Boll.* Dallas Daily Herald, Oct. 7, 1880.

patriot, Professor Louis Agassiz, with whom he long had corresponded. Agassiz received him affectionately and sent him to Texas "on expense," where he made a large collection of minerals, plants, insects, and other animals for the Harvard museum. He remained in Texas about a year. Among the specimens sent to Agassiz during this time were two of a new species of snake, later (1883) described by Garman as *Amphiardis inornata*.[6] During the winter of 1870 he returned to Cambridge, where he had an unofficial position with Agassiz as custodian in the department of zoology at Harvard. Early in the spring of 1871 he journeyed to Switzerland, where his cantonal government demanded his services in the investigation of the phylloxera-pest of the grape. He had, however, previously written Agassiz from Switzerland regarding appointment to an Assistantship in the Museum of Comparative Zoology. Agassiz wrote to him in a most cordial vein, and Boll, led by a sense of obligation, returned to Cambridge. As all of Agassiz's letters are of worth in showing the personality of this great teacher, and this is of exceptional value in showing his estimate of Jacob Boll, this letter is here reprinted in its entirety.

(Letter from Professor Agassiz to Jacob Boll.) [7]

Cambridge, Mass., den 9ten May, 1871.

Mein lieber Herr Boll,

Ihr Brief ist mir schon vorigen Monat zugekommen, aber ich konnte eigentlich nicht unmittelbar antworten, weil ich mit Sorgen so überhäuft war, dass ich mich nicht recht zu einem deutlichen Entschluss bringen konnte. Heute sind diese äusseren Schwierigkeiten überwunden and ich beeile mich nun Ihnen meinen Vorschlag zu bestätigen, dass Sie nach Cambridge kommen and eine regelmässige Verbindung mit unserm Museum eingehen. Ich biete Ihnen als Besoldung $100.00 monatlich and ihre Reisenkosten hierher, sowohl als auf etwaigen Excursionen und Reisen während Ihres Aufenthalts in den Vereinigten Staaten. Bei dem

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[6] GARMAN, S. *The Reptiles and Batrachians of North America.* Memoirs Mus. Comp. Zool., vol. 8, no. 3, 1887.

[7] Letter in Beilharz Collection. Partially reproduced in fac-simile in the *Dallas Morning News*, Oct. 21, 1928.

gegenwärtigen Zustande unserer Anstalt wäre es mir besonders erwünscht, wenn Sie recht bald kommen könnten, da ich selbst gegen Herbst eine Reise antreten werde and es mir wichtig wäre, vor meiner Abreise mich mit Ihnen and Dr. Hagen gemeinschaftlich über die vorzunehmenden Arbeiten für den Winter besprechen zu können. Es versteht sich von selbst, dass bei einer Anstellung, die vor der Hand nicht als lebenslänglich betrachtet werden kann, es Ihnen mir frei stehen sollte, entweder jährlich oder halbjährlich den Vertrag aufbünden zu können, und um Ihnen zu zeigen, wie ernstlich es mir zu tun ist, Ihren Wünschen zu entsprechen und Sie zu bewegen, dieses Anerbieten anzunehmen, will ich es Ihnen überlassen zu bestimmen, wie Sie es hiermit halten wollen. Nur eines wünsche ich Sie recht angelegentlich zu berücksichtigen, dass es für mich wie für unsere Anstalt von Wichtigkeit wäre, wenn Sie möglich bald hierher kommen könnten.

Es hat mich sehr gefreut zu vernehmen dass Sie glücklich in Ihre Heimath zurückgekehrt sind, and die Ihrigen alle wohl befunden haben. Mit der Sendung der noch in Ihren Händen befindlichen Exempläre hat es keine Eile. Sie könnten dieselben ebensogut selbst mitbringen.

Freundschaftlichst, Ihr

L. AGASSIZ.

No sooner had he returned to America, than the very severe illness of his wife in a hospital in Switzerland, recalled him to her side, and there he remained until her death in August, 1873. After her death Agassiz renewed his invitation. Although the hand of illness was heavy upon him, he wrote, in a script that betrayed his physical infirmity, the following letter but two months before his own death on December 14, 1873. It is characteristic of Agassiz that in his own suffering he still could be solicitous for the happiness of others, as this letter shows.

(Letter from Professor Agassiz to Jacob Boll.) [8]

Cambridge, den 15. Oktober, 1873.

Lieber Herr Boll,

Da der Herbst heranrudert kann ich wohl voraussetzen, dass Sie von Ihren Sommerexcursionen zurückgekehrt und jetzt wieder zu Hause sind; vielleicht erwarten Sie schon seit einiger Zeit meine Antwort. Ich bin aber diesen Sommer so sehr in Anspruch genommen worden, dass mir die Zeit unbemerkt vorübergegangen ist. Auch bin ich wirklich unwohl gewesen, obgleich nicht gefährlich, wie die Zeitungen es gemelden.

[8] Letter in Beilharz Collection.

Sie sind richtig unterrichtet worden als Ihnen gesagt wurde, unsere Anstalt habe bedeutliche Mittel erhalten, und ich bin in jeder Weise bemüht die Sammlungen zu erweitern. Ihre Rückkehr wird daher wilkommen sein. Sie werden indess einen neuen Mitarbeiter im entomologischen Fach, neben Herrn Dr. Hagen finden, Herrn Crotch, früher in Cambridge in England, und einige jüngere Gehülfen. Auch die Sammlung ist durch Ankäufe bedeutend vermehrt. Es freut mich zu vernehmen, dass Sie in den Ordnungen gesammelt, die nicht so allgemein berücksichtigt werden. Bringen nur Sie alles mit, was Sie zusammentreiben können. Es wäre mir auch lieb, wenn Sie von ganz gemeinen Sachen Massen sammeln könnten für den Gebrauch unserer Studenten. Ich hoffe, Sie haben selbst daran gedacht, denn in dieser Jahreszeit kommt ein solches Verlangen zu spät.

Es würde mich freuen zu vernehmen, dass Ihre traurigen Verhältnisse sich ruhig gelegt haben.

Freundschaftlichst, Ihr

Herrn J. Boll. L. AGASSIZ.

There could be but one reply. Jacob Boll returned for the last time to Cambridge. On arriving in America in January, 1874, he learned that his old preceptor and friend, Agassiz, had died. Feeling that the old days had passed away, he turned to Texas, where his aged mother and her other children lived. For seven years, from 1874 to the time of his death, Boll investigated the geology and mineral resources, and the natural history of Texas. His field work was of conspicuous importance in both the field of geology and natural history, and will be presently assessed under those heads (*vide infra.*) In the absence of a geological survey, he made careful studies in the field, particularly in Northern and Western Texas; and it was on one of these field trips, in Wilbarger County, on September 29, 1880, that he died of appendicitis, after an illness of ten days.[9]

Finally, in this brief sketch, a few words about the *man* may be in order. In stature and appearance he was of less than usual height. His brow was broad and high, his eyes greyish-blue, his countenance *heiter*. He was a merry but

[9] Obituary notices appear in the *Galveston Daily News*, Oct. 10, 21, 1880; and *Dallas Daily Herald*, Oct. 1, 19, 1880. See Note 5, *supra*.

quiet companion, of singularly gentle and kindly disposition. He was a character in his day among the ignorant of Dallas who could not appreciate the familiar figure in long yellow duster and with collecting case in hand.

II.

Professor Boll was introduced to the geology of the Southwest under peculiar circumstances. In the late 'seventies a battle of the Titans was on in the field of Vertebrate Palaentology, between Prof. Othniel C. Marsh of Yale College and Professor Edward D. Cope of Philadelphia. Marsh (whose generous impulses were rarely stirred when a fellow-scientist was involved) bitterly resented the encroachment of a man nine years his junior upon the field of vertebrate paleontology, for he conceived this field to be his private preserve. Such an attitude bred bitter resentment in Cope, with the result that both men furiously collected, studied, and published in attempts to anticipate each other in the discovery and publication of the fossil vertebrates of the West. Cope from 1871-77 had carried on explorations in the Cretaceous of Kansas and the Tertiary of Wyoming and Colorado. He had also worked with the United States Geological Survey in New Mexico (1874), Montana (1875), and Oregon and Texas (1877.) Cope came to Dallas several times during the summer of 1877; the first time to visit an amateur botanist of some distinction, Julien Reverchon, and to seek advice in the securing locally of a collector of vertebrate fossils from the beds then considered as of Triassic age but now known to be Permian. Mr. Reverchon recommended the selection of Boll, who as a result was sent out in the spring of 1878 into what was then the wilderness of Northwest Texas, the Permian country. His first fossil vertebrate of the Permian was collected on Onion Creek, a tributary of the Little Wichita River in Archer County. Amazing collections of fossil vertebrates were later collected at various points along the Big and the Little Wichita and their confluents.

The Wichita beds became famous in the scientific world as the repository of a series of strange forms of remarkable primitive Batrachia with complex vertebrae; primitive reptilia; and lung fishes. "Subsequent [collection] installments revealed a new and wonderful fauna rich in species and often offering widely from any previously known."[10] In a paper published in May, 1878, Cope[11] described new genera and species of Ctenodontid *Dipnoi,* Archegosaurid, Cricotid, and Eryopid *Stegocephalia,* Diadectid and Pariotichid *Cotylosauria,* and Clepsydropid and Bolosaurid *Pelycosauria.* Other new species were described in papers in the years 1878-84,[12] and subsequently. Very many of these new species were collected by Professor Boll.

He early recognized the "Red Beds" of Northern Texas as of Permian age. As Dr. Robert T. Hill has said (*op. cit.,* p. 66), "Prof. Jacob Boll made the first intelligible announcement of the Permian in Northwest Texas in a brief sketch in the *American Naturalist* for 1880.[13] He mentioned his explorations of the previous field season which extended over the entire length of the Little Wichita River and its confluents. As the result of this six months of exploration he announced that he had discovered many new 'plants and animals, consisting of petrified ferns, fishes, and reptiles.' These, he asserted, all belonged to the transitional period, and especially to the lower and upper Permian." This paper was published (the month of Boll's death) with the approval of Cope, who at the time was one of the editors of the *American*

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[10] GILL, T. *Edward Drinker Cope, Naturalist—A Chapter in the History of Science.* Science, n. s., vol. 6, pp. 225-243, 1898. p. 232.

[11] COPE, E. D. *Descriptions of extinct Batrachia and Reptilia from the Permian Formation of Texas.* Proc. Amer. Phil. Soc., vol. 17, pp. 505-530, 1878.

[12] *See* COPE, in *American Naturalist,* 12:57, 327-28, 406-08, 565, 633, (1878); *Proc. Amer. Phil. Soc.* 17:172-193, 505-530; 19:38-58; 20:447-74, 627-36 (1880-83); *Amer. Naturalist* 14:609-10 (1880).

[13] BOLL, J. *Geological Examinations in Texas.* American Naturalist, vol. 14, pp. 684-686, 1880.

Naturalist. That Cope valued Boll highly as a collector appears from the short biographical sketch of him in *Appleton's Cyclopaedia of American Biography*[14], inspired by Cope, in which it is said: "Mr. Boll made many important discoveries in the formations that he explored. He was an expert naturalist, and a most successful collector in many departments of natural history." Hill (*l. c.*), writing seven years after Boll's death also speaks appreciatively of him as "an able Swiss zoologist and geologist" whose "writings were only the introduction to what promised to be valuable original contributions to the geology of Texas." His death was a loss amounting to tragedy for Texas science.

One may remark in passing that the Rev. W. F. Cummins, a friend of Professor Boll, was appointed at his death to continue his work. He developed into a very capable collector and field-man, and on the establishment of the Dumble Survey of Texas in 1888, became Assistant State Geologist.

Boll made studies on the mineral resources of Texas for Cope and eastern capitalists. In his 1880 paper (*vide* note 13, *supra*) he noted the occurrence of lead, zinc, copper and iron ore along the Big and Little Wichita rivers. The state Geological Survey had been terminated in 1876, and from that time until his death Boll had served in a volunteer capacity. At the time of his death there was some movement to resume the office of State Geologist, and to appoint him to fill it. As he "enjoyed the fullest confidence and esteem of Governor Roberts, Senator Coke, and nearly all public men" it is probable that had he lived he would have been made State Geologist of Texas[15].

III.

Professor Boll was a gifted and versatile student of both botany and zoology. His seventeen years of devotion to the study of the natural history of his own Canton came to

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[14] Volume 1, p. 307, 1887.

[15] [BROWN, J. H.] *Dallas Daily Herald*, Oct. 7, 1880.

fruition in his *"Verzeichnis der Phanerogamen- und Kryptogamen-Flora von Bremgarten. . . ."*—the thin duodecimo referred to above. In the preface, dated July 9, 1869, he states that after his return to Bremgarten in 1853 he had continually collected and studied the animals and plants of his locality. The *Verzeichnis* gives notes on 1386 species of plants (307 of them are Cryptogams.) Boll grounded himself so well in natural history that when he returned from America the *Regierungsrath* of the Canton Aargau [16], wrote him a formal letter and authorization, requesting him to make, in Texas, collections of the seeds of the common forest trees, as well as marine and freshwater shells, and Texas fossils. He was also later (1875) asked to make up biological sets on the Colorado potato-beetle (only just then becoming a pest in America), and a letter of thanks from the *Regierungsrath* [17], records the safe arrival of beetle collections in such abundance that every school in the Canton had specimens for its students.

In 1874 he was commissioned by a group of French scientists to investigate the native silkworms with a view to introducing hardier species into France. In the *Galveston Daily News* of Oct. 10, 1880, Mr. N. A. Taylor states that Professor Boll was offered $8,000 for a large collection of Texas minerals and plants, but one is inclined to consider the detail an error. Beside the extensive collections of animals, plants, and minerals made for the Harvard Museum, and of insects made for the Peabody Museum at Salem, he also collected fishes, reptiles, and amphibia for Cope. (*Vide infra.*) He was appointed a member, in charge of Texas, of the U. S. Entomological Commission for the study of the Rocky Mountain locust, under Dr. Charles V. Riley. During all this time Boll was corresponding with zoologists everywhere. Riley [18]

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[16] Letter from "Regierungsrath des Kantons Aargau" to Jacob Boll, of date March 6, 1871. (Beilharz Collection.)

[17] Of date Sept. 19, 1877. (Beilharz Collection.)

[18] RILEY, C. V. *Trans. Acad. Sci. St. Louis, 1868-1877*, vol. 3, p. clxxiii, 1878.

recorded (in a paper read at the March 16, 1875, meeting of the St. Louis Academy of Sciences) correspondence with Boll and exhibited before the Academy four types of freshwater crustacea sent on from Dallas. Professor Philip Zeller[19] described several new species among the Geometrid moths from material collected by Boll for Agassiz, and subsequently corresponded and exchanged with Professor Boll personally. How extensively and how profitably Boll collected in these early days may be seen by thumbing carefully, say, Cresson's[20] *Hymenoptera Texana* (1872), and Packard's[21] *Monograph of the Geometrid Moths* (1876), where new species are described from Texan collections of J. Boll and G. W. Belfrage, and valuable observations added from their notes. With all of these entomologists he was in close correspondence. R. Ellsworth Call[22] described a new species of freshwater clam from Dallas, *Unio bolli* (= *Quadrula aurea* Lea) in 1881, and Professor Cockerell in 1910 described a bee, *Nomia bolliana*, based on specimens collected in the early days at Dallas by Jacob Boll.

He collected insects of all sorts for museums over the entire world, but in his own collection specialized on microlepidoptera. At Boll's death this large collection, together

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[19] ZELLER, P., in *Verhandl. d. Bot.-Zool. Gesellschaft in Wien*, vol. 22, *circa* pp. 470-500, 1872.

[20] The *Introduction* to this work tells of the excellent collecting done in Texas by BELFRAGE in Bosque county, BOLL in Dallas county, and HEILIGBRODT in Bastrop and Travis counties. For an excellent account of this distinguished naturalist, who for a short time resided in Texas, see P. P. CALVERT: *"Ezra Townsend Cresson, a Contribution to the History of Entomology in North America,"* (Trans. Amer. Entom. Soc., vol. 52, Supplement, pp. i-lxiii, 1928.)

[21] PACKARD, A. S. *A Monograph of the Geometrid Moths or Phalaenidae of the United States.* Rept. U. S. Geol. Surv. Territories, vol. 10, 1876.

[22] CALL, R. E. *Unio bolli, New Species.* American Naturalist, vol. 15, pp. 390-91, 1881.

with his notebooks, passed into the hands of B. Neumoegen and Dr. Charles V. Riley, as appears in a letter from Riley[23].

Professor Boll had also a lively interest in experimental zoology. He had a large colony of silkworms in Dallas, fed them various sorts of food, and noted the quality of silk produced with the diverse types of food. He found, among other things, that the finest quality is produced indifferently on mulberry and Osage-orange (*Maclura*) leaves. He also carried American species of silkworms to Switzerland and noted changes occurring in them with new climatic and food conditions. Relative to his silkworm experiments, a letter from Professor Moritz Wagner[24] of Munich, dated Oct. 11, 1873, gives a very compact picture of the impression made upon a competent European authority by the work of Professor Boll. It is here reproduced in its entirety:

(Letter from Professor Moritz Wagner to Jacob Boll.)

München, den 11. Oktober, 1873.

Geehrter Herr!

Ihre werten Zeilen vom 9. Oktober trafen mich auf dem Krankenbett, auf welchem mich ein schmerzliches Leiden seit einigen Wochen festhält. Sobald ich im Stande sein werde, auszugehen, werde ich Ihnen die gewünschte Entschädigung für die mir gefälligst überlassene *Saturnia luna* bestehend aus einigen seltenen Vogelbälgen, besonders Colibris aus der Schneeregion der Anden von Ecuador, mit der Sie dem Museum von Cambridge gewiss grosse Freude machen, sowie einige Schmetterlinge von Chimborazo, wahrscheinlich auch neue nicht beschriebene Species, in einer Schachtel per Post zusenden. Diese Gegenstände liegen leider nicht in meiner Wohnung, sondern im Akademiegebäude.

In meiner nächsten grösseren Schrift: "Neue Beiträge zu den Streitfragen der Entwicklungslehre" werde ich des sehr interessanten Falles der raschen Veränderung des von Ihnen nach der Schweiz versetzten Spinners, schon in der zweiten Generation, sehr ausführlich erwähnen, und dabei das hohe Verdienst betonen, das Sie sich durch diesen ausserst merkwürdigen Versuch um die Wissenschaft, gerade in einer so brennenden Streitfrage, erworben haben. In die *Augsburger Allge-*

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[23] Letter from C. V. Riley to Mrs. Henrietta Beilharz, of date May 10, 1881. (Beilharz Collection.)

[24] From Beilharz Collection.

meine Zeitung, welche sehr verbreiten und viel gelesen wird, werde ich aus dieser Schrift zuvor einen Auszug geben und Ihres Verdienstes gleichfalls in der anerkennendsten Weise erwähnen.

Dass Sie jezt im Begriffe sind, das Experiment in entgegengesetzter Richtung zu wiederholen, d. h., Puppen oder Eier von europäischen Schmetterlingen nach Amerika mitzunehmen, interessiert mich ausserordentlich. Ich werde Ihnen dazu ganz besonders die häufigeren Arten der Gattungen *Euprepia Catocala, Pluria* u. s. w. überhaupt die allergemeinsten und fruchtbarsten Arten, besonders aus der Familie der Bombycis empfehlen. Durch Wechsel der Nahrung, des Klimas, u. s. w. werden sich nach meiner Ueberzeugung gerade aus solchen häufigen Arten am leichtesten stärkere Variationen erzielen lassen. Sie würden mich zum grössten Dank verpflichten, wenn Sie mich von den Resultaten dieser Versuche seiner Zeit in Kenntniss setzen wollten.

Mit ausgezeichneter Hochachtung,

Ihr dankbarst ergebener

M. WAGNER.

K. Universitäts-Professor
Maximilienstr. 21.

Perhaps Boll's most *conspicuous* service in the field of recent zoology lay in the collections made for Cope of reptiles, amphibians, and fishes in northern and western Texas. For this purpose he ranged from the Red River on the north to old Fort Concho (now San Angelo, in Tom Green County) on the south and west. In his paper, entitled, *"On the Zoological Position of Texas"* [25] Cope lists in detail Boll's collections at various localities in this area. Four (or five) new species of recent vertebrates are described from material Boll collected: "Boll's Spotted Lizard" (*Holbrookia maculata lacerata* (Cope)), the "Blunt-Tailed Skink" (*Eumeces pachyurus* Cope, of which the unique type-specimen, from Dallas, has been lost), the "Short-lined Skink" (*Eumeces brevilineatus* Cope) found at Fort Concho immediately after Marnoch had discovered it at Helotes Creek, and "Boll's Sucker" (*Ameiurus bolli* Cope) described from the waters of the Little Wichita

[25] COPE, E. D. *On the Zoological Position of Texas.* Bulletin no. 17, U. S. Nat. Museum, 1880.

River. To this group of new species must be added, of course, "Garman's Snake" (*Amphiardis inornatus* Garman) collected at Dallas, and now in the Museum of Comparative Zoology at Cambridge.

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A REVIEW OF THE GENUS LICHENOCRINUS AND DESCRIPTIONS OF TWO NEW GENERA.[1]

CHARLES L. FABER.

I. INTRODUCTION AND ACKNOWLEDGMENTS.

Since 1886, when Hall defined the genus *Lichenocrinus*, several species have been described but no comprehensive study of the genus has been made. The purposes of this paper are to discuss the structure, to review most of the described species and to describe new forms of the genus *Lichenocrinus* and to define two new genera, *Xenobasis* and *Cystoidosaccus*.

The work is based on an examinaiton of over two thousand specimens; more than half of these are in my own collection and the rest are in other collections and museums. Much of this material I myself have secured in the field but some of it was contributed by friends, whose services are acknowledged in the names of new species. Thanks are extended also to Mr. A. W. Slocom of the Walker Museum of the University of Chicago, Dr. C. A. Reeds of the American Museum of Natural History and Dr. R. S. Bassler of the U. S. National Museum, who have loaned types and other specimens for study. I have been assisted in the work by Mrs. Mildred Adams Fenton, who has searched the Miller Collection at the University of Cincinnati for types and other specimens

[1] Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 8.

and has made the photographs and prepared the plates illustrating this paper.

In giving the location of the type and other specimens considered in this paper the following abbreviations have been used both in the text and in the plate explanations, catalogue numbers preceding them:

A. M. N. H.—American Museum of Natural History.
C. L. F.—Collection of Charles L. Faber.
S. R. W.—Collection of S. R. Williams of Miami University.
U. C. M.—University of Cincinnati Museum.
W. H. S.—Collection of W. H. Shideler of Miami University.
W. M.—Walker Museum, University of Chicago.

II. METHODS OF STUDY.

There are numerous varieties or types of *Lichenocrinus* in formations from the Black River, through the Trenton, Cincinnatian and Richmond and into the Fernvale. The number of forms or species is far greater than that described in this paper, which serves as an introduction to, rather than a summary of this complex group.

In considering *Lichenocrinus* various authors have held different concepts of species. We have, on the one hand, *L. pattersoni* Miller based on one specimen; and on the other, Meek's interpretation of *L. crateriformis* Hall which includes abundant specimens belonging to several distinct taxonomic groups that extend from the Eden through the Richmond. A comprehensive study, therefore, calls for some general concept of species as well as of characters on which they may be based.

This is difficult because *Lichenocrinus* is but one part of an organism, the part generally considered diagnostic, (the calyx), being unknown. The conclusions reached from the material at hand, therefore, are only approximate. The descriptions and names given to the forms are designed to aid in future study of the genus.

That the species designated may be as distinct as possible only the extreme or most clearly marked specimens have been selected. These give the major stages of variation or evolution into which minor stages or varieties later may be fitted.

In this study I have figured the most perfect specimen that could be found so that it will not be difficult for the eye to see the characters of the various species and in so far as possible, have selected specimens of equal size in showing the differences between related forms. This will be noted in the cases of *L. fentonae, L. pattersoni* and *L. twitchelli* and in another group composed of *L. tuberculatus, L. nodosus* and *L. shideleri,* also in *L. dubius, L. stetteri* and *L. vaupeli.*

In determining species I have used all the characters exhibited by the forms. They are:

1. General appearance.
2. Condition of the crater.
3. Arrangement and ornamentation of plates:
    a. Crater
    b. Body
    c. Rim.
4. Column, when present.

III. STRUCTURE OF LICHENOCRINUS—TERMINOLOGY

The organism represented by *Lichenocrinus* consisted of a calyx, a column and a basal body. Of the first we have no examples whose relationship to *Lichenocrinus* is assured. Though in 1898, G. Ashmann, A. Albers and I found a colony of *Lichenocrinus* in the Economy of Plaineville, Ohio. All specimens had columns, some three inches in length, attached to the bases. Three of the specimens were complete with calyx, column, and basal body. One of the calyces had three arms consisting of elongated plates; none of the arms showed bifurcation. These specimens were left in the care of Mr. Albers, an artist who at that time was engaged in illustrating some of my papers. Just before Mr. Albers' death these speci-

mens along with part of his collection disappeared. I hope that some day they will come to light. Even though these specimens cannot be found it seems desirable to record their discovery. There have been, however, quite a number of small calyces found associated with *Lichenocrinus*, but none of them have had enough of the column attached to show the characteristics peculiar to the *Lichenocrinus* column.

In the Austin Collection at the U. S. National Museum are three calyces originally associated in one slab with the basal bodies of *Lichenocrinus*.[2] These calyces retain so little of the column that the characters common to the known *Lichenocrinus* columns are not clear. Since the complete specimens in the Albers Collection are lost and the calyces of the Austin Collection cannot definitely be referred to *Lichenocrinus* no calyx of *Lichenocrinus* is known with certainty.

A. COLUMN

The columns of *Lichenocrinus* are perforated throughout; each columnal consists of five thin plates which form an alternating and interlocking system that extends about one and one-half inches above the basal body, beyond which it gradually changes to alternating and abutting and finally abutting only. The five plates of each columnal are distinctly marked throughout the length of all known columns. A pentagonal column with an abrupt change to a smaller pentagonal form has the alternating and interlocking system ending at the place of sudden change. Farther on it becomes semi-round and tapers toward the calyx. In a pentagonal column gradually becoming round and tapering, the alternating and interlocking system extends no more than one and one-half inches above the base. In the case of round columns, with no other change than tapering, the alternating and interlocking system also extends not more than one and one-half inches. These three forms have the plates of each columnal

[2] Dr. Bassler gave a short discussion of this material at the meeting of the Palaeontological Society in 1927. These specimens are described at some length in a paper by Mrs. Fenton. This issue, p. 491.

parallel and uniform in thickness. Another type of column is round and gradually tapering with plates of varying shape and thickness.

There are, therefore, four known types of *Lichenocrinus* columns, figured on Plates XXVII and XXX. Their characters may be briefly summarized as follows:

1. Pentagonal, changing abruptly to a smaller pentagonal form and finally becoming semi-round and tapering. This type is represented by *L. dubius, L. crateriformis* and an undetermined species from the Southgate.
2. Pentagonal, becoming round and tapering. This type is found in a form related to *L. crateriformis.*
3. Round and gradually tapering. This type of column is found in *L. dyeri* and undescribed forms from the Eden and the Elkhorn.
4. Round and gradually tapering with unequal plates. This type is represented by unattached columns from the McMicken.

B. BASAL BODY

The basal body, known as *Lichenocrinus,* is a more or less depressed convex disk attached to foreign objects. Its parts are given the following terms:

The floor plate, consisting of one piece, formed the attachment of the basal body to foreign objects. The *radial lamellae* rise vertically from the floor plate with which they are continuously united. As the floor plate grew in size peripherally, new lamellae were intercalated between the primary ones, thus forming the secondary series which does not reach the center. Between the lamellae are radial canals formed by them. In most forms the primary lamellae reach the center and form an elevation that is here termed the *node.* In highly convex specimens the lamellae are high, while in those with many body plates the lamellae are numerous.

The *node* is the central elevation beneath the column.

The *arch plate* rests on and covers the lamellae extending

peripherally as far as the floor plate. It seems to be of one piece and forms a support for the crater, body plates and superior rim plates. In some cases the outlines of the plates can be seen on the arch plate; the under surface so far as seen is smooth. In some cases there is below the arch plate a secondary calcareous deposit extending into and filling the radial canals. The arch plate so far has been observed in only *Lichenocrinus tuberculatus* and *L. nodosus;* it no doubt will be found in all species.

The *crater* is a depression surrounding the column. In some forms the crater is so small that if plates exist they cannot be seen, in others the crater is formed by one or two series of plates. In still others the crater is as large as half the diameter of the entire basal body and contains many series of plates; in such species the crater is flat. Where the basal body is highly convex, the crater is deep.

The *crater plates* form the depressed area around the column. They are smooth and thinner than body plates and range from a few to many in number. The way in which they were attached to the column is unknown.

Just beyond the crater plates are the *body plates.* In the more convex forms with high radial lamellae the body plates rest directly upon them or on the arch plate when it is present. There are three or more series of body plates and from a few to more than a thousand in each specimen. They may be of any size or shape and smooth or ornamented. The body plates increase in thickness toward the crater. The characters exhibited by these plates furnish the basis for specific distinctions.

Rim plates are the small plates at the margin of the basal body. There are from one to six series nearly always visible; on free specimens, however, one to three more rows of plates can be seen on the under surface. These plates are on a level with and attached to the floor plate though a slight break or demarcation can be seen between them. A series of specimens ranging from young to mature show that these rim plates are the last to have been added in the development of the

basal body, growth having taken place peripherally from the central region. In some forms the increasing age of the organism is accomplished by a marked decrease in the size of the newly added plates. The change from body to rim plates may be abrupt, in which case the latter are clearly demarked; if the change is gradual, the rim plates are of the same general appearance as the body plates and the demarcation is less distinct. Such a gradual change is found in forms with small body plates. In some species these newly added plates do not form a complete series, thus causing the periphery to become uneven.

IV. HABITS OF LIFE.

As has been said, *Lichenocrinus* is the basal portion of an at present unknown crinoid. Its function, like that of other bases, is to attach the organism either to the sea bottom, which frequently is composed of fragments of organisms, or some other firm ancorage. The common hosts are: bryozoans, brachiopods, and crinoid columns; such hosts will be seen in the illustrations. The less common hosts are pelecypods, trilobites and cephalopods; these may appear to be less common because from such smooth surfaces, or surfaces formed of aragonite, the *Lichenocrinus* are more quickly freed after their death or upon exposure to recent weathering. It is of interest to note that the basal surface or floor plate of the larger number of free specimens is relatively smooth, thus indicating that they are more easily freed from such surfaces as those of trilobites and cephalopods. One free specimen, however, (Plate XXVIII, Fig. 9), does bear the markings of its host, a *Strophomena*, while another, (Plate XXVIII, Fig. 11), bears faint markings of a *Pterinea*.

In their attachment, the *Lichenocrinus* bases show great power of adaptation to uneven surfaces. Not infrequently basal bodies are found entirely encircling slender bryozoans, (Plate XXIX, Figs. 3-4); others adhere to crinoid columns, (Plate XXIX, Fig. 2 and Plate XXXI, Fig. 2), their growth following the elevations and depressions of the columnals. A

specimen of *Lichenocrinus tuberculatus* Miller, (Plate XXVIII, Fig. 14), became subovate as its growth followed the side of the mesial fold of a *Platystrophia.*

In the specimens that I have collected and examined, I have never seen more than one species or variety attached to one host or small nodule; a nodule from the Southgate, (Plate XXIX, Fig. 1), has eleven distinct individuals of *Lichenocrinus* and evidence of four or five more, all of the same species.

Like many other forms in the Cincinnatian, specimens of *Lichenocrinus* are frequently found in "pockets" or colonies. One such colony, containing approximately one thousand three hundred specimens, was found in the Elkhorn. Of the three hundred specimens, from it in my collection, all belong to *Lichenocrinus tuberculatus* Miller; each specimen, except for a few, is attached to an individual. Four sets of specimens, two with two organisms and one with three were crowded together. In this same colony are seven individuals, each bearing two distinct columns; two of these are shown on Plate XXIX, Fig. 6.

In another "pocket," in the Waynesville in a creek east of Pekin, Ohio, I found over three hundred specimens of *L. crateriformis* Hall associated with over six hundred specimens of *Reteocrinus nealli* (Hall). These specimens were on slabs and some individuals of *Lichenocrinus* were attached to the columns of *Reteocrinus.*

V. DESCRIPTIONS.

GENUS LICHENOCRINUS HALL.

Genotype *Lichenocrinus dyeri* Hall.

Lichenocrinus Hall, 20th Rept. N. Y. State Cab. Nat. Hist., (adv. sheets), p. 9, 1866; a reissue of the same, pl. 3, figs. 1-6. 1871.

Lichenocrinus Meek, Ann. Mag. Nat. Hist., 4th ser., vol. 8, p. 341. 1871.

Lichenocrinus Meek, Am. Journ. Sci. and Arts, 3d ser., vol. 2, p. 299. 1871.

Lichenocrinus Hall, 24th Ann. Rept. N. Y. State Mus. Nat. Hist., p. 216, pl. 7, figs. 1-7. 1872.

Lichenocrinus Meek, Ann. Mag. Nat. Hist., 4th ser., vol. 9, p. 247. 1872.

Lichenocrinus Meek, Am. Journ. Sci. and Arts, 3d ser., vol. 3, pp. 15 and 261. 1872.

Lichenocrinus Meek, Geol. Surv., Ohio, vol. 1, pt. 2, pp. 44-51. 1873.

Lichenocrinus Sardeson, Am. Geol., vol. 24, p. 275. 1899.

Lichenocrinus Bather, Treatise on Zool., pt. 3, Echinoderma, p. 77. 1900.

Description.—"Bodies parasitic on shells and other foreign substances. From discoid or depressed-convex, with a proboscidiform appendage rising from the center. Disc composed of an indefinite number of polygonal plates, and apparently having no distinct mode of arrangement. Proboscis perforate, and in the known species formed of five ranges of short plates alternating and interlocking at their margins." (Hall.)

Remarks.—When Hall wrote the above description of *Lichenocrinus* he evidently held the opinion that the column was homologous with the ventral tube of some crinoids. He later, however, considered the appendage a column. Meek, in 1871, suggests that the discs might be the peculiarly constructed basal attachment of a crinoid, whose calyx had not been associated with the column and base. From the material now at hand there seems to be no doubt that *Lichenocrinus* is a basal attachment of a crinoid.

No formal abbreviated definition is here given because the section on the structure of *Lichenocrinus* is essentially an elaborate description of the genus.

LICHENOCRINUS PATTERSONI MILLER.

Plate XXX, Fig. 6.

Lichenocrinus pattersoni Miller, Journ. Cincinnati Soc. Nat. Hist., vol. 2, p. 118, pl. 10, figs. 6-6a. 1879.

Description.—"Body robust, round or sub-circular, plano-convex, with a depression around the column, composed of numerous plates of unequal size, having no regular geometrical form, and disposed without any definite order of arrangement. If the plates, in the specimen illustrated, could be arranged, in regular concentric series, there would be, about eighteen ranges, between the column and the circumference.

"The plates are smooth.

"The column-like appendage is large, round and composed, as in other species, of five ranges of thin plates.

"The plates, in this species, are as large as the plates in *L. crateriformis*, and as numerous as in *L. dyeri*, but they have neither the arrangement nor form of either." (Miller.)

Dimensions of the holotype: diameter of the body 16 mm.; diameter of the crater 4 mm.; diameter of the column 3 mm.

Remarks.—*L. pattersoni* is a very distinct form and it need not be compared with any other species. The plates are flat and smooth, though if the specimen were not weathered they might appear granulose. Many of the plates are cuneiform and sharply angular; some of them, however, have slightly curved sides, a character peculiar to this species. The open character of the sutures is probably a result of weathering.

Occurrence.—The holotype was found in the Cynthiana in the river quarries of West Covington, Kentucky. It was associated with *Dendrocrinus dyeri* (Meek) and *Lingulops norwoodi* (James).

Holotype.—No. 8842, W. M.

LICHENOCRINUS FENTONAE N. SP.

Plate XXIX, Fig. 1; Plate XXX, Figs. 7-8.

Description.—Basal body is large, semi-circular and slightly convex. The semi-round column, each columnal of which is composed of five thin plates, occupies nearly the entire crater area; no crater plates can be distinguished. The body plates are numerous, slightly convex, granulose, irregularly

polygonal and generally radially elongate, though there are a few small plates scattered among the large ones. There are approximately ten circular series though the decrease in size of the plates toward the margin makes the circular arrangement less clear. The superior rim plates are distinguished from the body plates by their small size and peripheral position. The floor plate is very thin and bears distinct, though low, lamellae.

Dimensions of two cotypes, the one shown on Plate XXX, Fig. 7 and the other the right hand specimen shown on Plate XXX, Fig. 8: diameter of the body 13.9 and 19.4 mm.; diameter of the crater 4 and 5 mm.; diameter of the column c 3.3 and 3.4 mm.

Remarks.—There is evidence of the attachment of thirteen specimens of *L. fentonae* on the nodule. They are associated with crinoid bases and three specimens of *Hemicystites*. This species is named in honor of Mildred Adams Fenton who has prepared the plates illustrating this paper and has taken a deep interest in the study of *Lichenocrinus*.

Occurrence.—The locality of the cotypes is unknown but the association of specimens on the nodule indicates that they came from the Southgate.

Cotypes.—No. 10991, W. M.

LICHENOCRINUS TWITCHELLI N. SP.

Plate XXXI, Figs. 6-10.

Description.—Basal body subcircular in outline and slightly convex. A comparatively large pentagonal column occupies nearly the entire crater area; the crater plates are small and mainly obscured by the column. The body plates of the holotype, the largest specimen, are smooth, flat, irregularly polygonal and nearly uniform in size, though there is a slight decrease in size toward the periphery; there are about one thousand paltes. The paratype shown on Plate XXXI, Fig. 7, the next largest specimen, has one to two series of convex plates around the crater and flat or convex plates to near the

margin where there are two series, or irregular groups, of small convex rim plates. The two other paratypes, the smallest of the specimens, have convex body plates with a tendency toward flatness and more distinctly convex rim plates. This would seem to indicate, therefore, that the convex body plates are characteristic of young individuals and as they matured the plates become flattened.

Dimensions of the holotype and the smallest paratype, shown on Plate XXXI, Figs. 9 and 7: diameter 15 and 4.5 mm.; diameter of the crater 4 and 1.8 mm.; diameter of the column 3 and 1.5 mm. (distorted).

The column of one paratype measures 20 mm., in this it tapers gradually. Each columnal is composed of five thin, alternating plates.

Remarks.—This species is named in honor of Dr. George B. Twitchell, who has assembled an interesting collection of Cincinnatian bryozoans.

Occurrence.—Southgate; the holotype and two paratypes are from Rapid Run Creek, near Cincinnati, Ohio; the paratype, shown on Plate XXXI, Fig. 6, was found by Dr. W. H. Shideler in Muddy Creek, near Cincinnati, Ohio, and presented by him.

Holotype.—No. 10001; *Paratypes.*—Nos. 10002, 10003 and 10013, C. L. F.

LICHENOCRINUS DUBIUS MILLER.

Plate XXIX, Fig. 9; Plate XXX, Figs. 1-3.

Lichenocrinus dubius Miller, Journ. Cincinnati Soc. Nat. Hist., vol. 3, p. 234, pl. 7, figs. 5-5a. 1880.

Description.—"The head is robust and covered with conical elevations. The plates are more numerous than in *L. crateriformis*, and they are thrown into elevations and depressions on the surface, which, if not abnormal, will alone distinguish this from all other species.

"The column, in comparison with that of *L. crateriformis*, is short and thick. For a distance of one inch from the head,

the column is fluted-pentagonal, the depression being at the point of union of the interlocking pieces. At the distance of an inch from the head the column is abruptly contracted and changed to a plain pentagonal form. From this point the column gradually tapers and changes from the pentagonal to circular form, so that at the distance of one and one-fourth inches from the head of the column is round and smooth. Our specimen shows but little of the circular part of the column, but we may fairly infer from the tapering character of the column that the total length did not much exceed one and a half inches." (Miller.)

Basal body depressed convex with a comparatively large, flat center which is surrounded by an irregular ridge composed, in typical specimens, of isolated elevations, the outer slopes of which are abrupt. Crater plates small, flat and irregularly polygonal; they are numerous and have no definite arrangement. The body plates are smooth, irregularly polygonal and larger than the crater plates; they are arranged in three or four circular series. The superior rim plates, represented by one or part of a circular series, are like the body plates; their uneven growth causes the irregular outline of the body.

Dimensions of the right hand specimen shown on Plate XXX, Fig. 1 and the one shown in Fig. 2: diameter 10.7 and 9.6 mm.; diameter of the crater 5.7 and 6 mm.; diameter of the column 1.6 and —— mm.

The column, though not complete, of Miller's type, Plate XXX, Fig. 3, is 30.6 mm. in length and 1.6 mm. in diameter. At a distance of 25 mm. from the base the pentagonal column changes abruptly in diameter and then gradually tapers. At the point of change the alternating arrangement of the plates gives way to the abutting system. A small portion of the column of the right hand specimen shown on Plate XXX, Fig. 1, (also Plate XXIX, Fig. 9), possesses the same character as does the column shown on Plate XXX, Fig. 3.

Remarks.—Though the specimen on which Miller based his species has the basal body poorly preserved and badly

distorted, the characters are sufficiently distinct to establish the form. In the Miller Collection at the University of Cincinnati a set of *L. dubius* was found, one specimen of which is figured on Plate XXX, Fig. 2, and is better preserved than the holotype.

Occurrence.—Fulton, Economy and Southgate.

Holotype.—No. 8783, W. M.; *Plesiotypes.*—Nos. 989, W. M., and 3875, U. C. M.

LICHENOCRINUS STETTERI N. SP.

Plate XXX, Figs. 4-5.

Description.—In general appearance this form is like *L. dubius* Miller; the large flat crater is surrounded by prominent isolated elevations. The crater plates are smooth and irregularly polygonal; those near the center are small while those nearest the elevations are large. The body plates are numerous, very irregular in size, shape and arrangement. On the outer slope are very irregular wide, short, convex plates that form depressions and the irregular outline of the body. The elevation to the right of the center of Fig. 5 has more than 60 plates. Dimensions of the holotype: diameter of the body 9 mm.; diameter of the crater 4-5 mm.; diameter of column 1 mm.

Remarks.—This species is named in honor of my friend, Fred M. Stetter, who has devoted more than forty years to collecting Cincinnatian fossils and has given his collection to the University of Notre Dame.

Occurrence.—Southgate, Rapid Run Creek, near Cincinnati, Ohio.

Holotype.—No. 10007, C. L. F.

LICHENOCRINUS SCHLEMMERI N. SP.

Plate XXXI, Figs. 1-3.

Description.—Basal body subcircular in outline and slightly convex. The small crater area is almost filled by the pentagonal column; the crater plates are few and small. The body plates are flat, smooth, irregularly polygonal and about

as wide as long; they decrease in size toward the periphery where they merge with the superior rim plates. The latter are distinguished by their small size.

The dimensions of the holotype are: diameter of the body 9.5 mm.; diameter of the crater 2.5 mm.; diameter of the column 2 mm.

Remarks.—This species is named in honor of my friend Charles O. Schlemmer, a veteran collector of Cincinnati, who has given me many specimens of *Lichenocrinus*.

Occurrence.—Southgate, Rapid Run Creek, near Cincinnati, Ohio.

Holotype.—No. 10005; *Paratype.*—No. 10006, C. L. F.

LICHENOCRINUS VAUPELI N. SP.

Plate XXXI, Figs. 4-5.

Description.—Basal body depressed convex with a comparatively large crater composed of one series of elongate polygonal plates and a few irregular ones. The rounded-pentagonal column occupies a small part of the crater. The body plates are large, hexagonal to octagonal and decrease in size toward the periphery. The plates forming the first series surrounding the crater are ornamented by etched lines parallel to the margins and by a low rounded elevation in the center of each. The plates forming the remaining two to three series have the etched lines and a depression, instead of an elevation, in the center of each. The few distinguishable rim plates bear the same type of ornamentation as the body plates.

Dimensions of the holotype: diameter 7 mm.; diameter of the crater 2-3 mm.; diameter of the column 1 mm.

Remarks.—This species is named in honor of E. H. Vaupel who has given and loaned me many specimens of *Lichenocrinus* and with whom I have collected.

Occurrence.—Associated with the recurrent Fulton fauna of the Southgate, Rapid Run Creek near Cincinnati, Ohio.

Holotype.—No. 10004, C. L. F.

LICHENOCRINUS ASHMANNI N. SP.

Plate XXXIV, Figs. 5-6.

Description.—Basal body irregular in outline, marked by a high, angular subquadrangular ridge which is broken by concave depressions. The crater, bounded by the inner slope of the ridge, is wide and comparatively deep, the discoid base of the column occupying only a small portion of the area. The crater plates are smooth, flat, comparatively large and irregularly polygonal; 2 to 3 alternating series from the column to the ridge. Some of the crater plates join the body plates on the crest of the ridge and others form the crest, with portions sloping toward the crater and toward the margin. The body plates are polygonal, irregular in shape and arrangement.

The plates forming the ridge show low pointed elevations in the center or at the angles of the plates, one or two on a plate. Probably three plates on a radius from the ridge to the margin. Superior rim plates are not distinct though at the margin of the floor plate one or two series of inferior rim plates can be seen. The arched floor plate shows that it was attached to a highly convex surface. A part of a circular series of plates, shown on Plate XXXIV, Fig. 6, seems to be the inferior surface of the body plates forming the ridge around the crater.

Dimensions of the holotype: maximum diameter 10.7 mm.; diameter of the crater 5-6 mm.; diameter of base of column 1.5 mm.

Remarks.—The conspicuous angular ridge characterizing this species is not the result of distortion, as at first might be supposed. The circular series of plates, part of which is shown on Plate XXXIV, Fig. 6 represents the under side of the ridge; these plates are heavy and thick, and leave no doubt that the ridge is a result of normal growth.

This species is named in honor of my friend, the late George Ashmann, a collecting companion for over fifty years.

Occurrence.—Mt. Hope, near Elberon Avenue Heights, Price Hill, Cincinnati, Ohio.

Holotype.—No. 10016, C. L. F.

LICHENOCRINUS DYERI HALL.

Plate XXVII, Fig. 5; Plate XXXIV, Figs. 7-12.

Lichenocrinus dyeri Hall, 20th Rept. N. Y. State Cab. Nat. Hist. (adv. sheets) p. 9, 1866; a reissue of the same, pl. 3, figs. 1-6. 1871.

Lichenocrinus dyeri Hall, 24th Ann. Rept. N. Y. State Mus. Nat. Hist. p. 216, pl. 7, figs. 1-6. 1872.

Lichenocrinus dyeri Meek, Geol. Surv. Ohio, Pal., vol. 1, pt. 2 p. 51, pl. 3, figs. 2 (and 3a-3b). 1873.

For additional references see Bull. 92, U. S. N. M., p. 722.

Description.—"Body small, discoid, depressed in the middle, with five slight elevations midway between the center and the edge of the disc. Proboscis strong, composed of short plates. Disc composed of very small polygonal plates. Surface smooth." (Hall.)

Basal body convex, crater large and steep sided; crater plates small and probably arranged in two series. The large semi-round column occupies nearly the entire crater area and obscures the crater plates. Body plates, convex and granulose, quadrangular to hexagonal, though generally pentagonal and quite irregular in size and shape. Hall's type, (Plate XXXIV, Fig. 8), as well as a plesiotype, show elongate, slightly wedge shaped plates toward the margin. Five to seven plates can be counted along a radius from the crater to the margin. Rim plates have the same character as the body plates, differing only in their smaller size. The free specimen shown on Plate XXXIV, Fig. 9, has portions of the floor plate near the margin; the inferior surface of the body plates bear traces of the radiating lamellae, upon which they must have rested directly. The central portion of the specimen shows the lamellae with matrix filling the inter-spaces.

Dimensions of two plesiotypes shown on Plate XXXIV,

Figs. 11-12: diameter 10.8 and 6 mm.; diameter of the crater 4.2 and 2 mm.; diameter of the column 3.5 and 1.5 mm.

A characteristic column of this species is shown on Plate XXVII, Fig. 5. At the base it is about one-third the entire diameter of the basal body; it shows a gradual tapering even in the 35 mm. of column preserved. Five comparatively thin alternating hexagonal plates form each columnal; at a distance of 30 mm. from the base the plates become quadrangular but still alternate. This heavy type of column appears to be a specific character.

Remarks.—Hall's figure of *L. dyeri,* reproduced on Plate XXXIV, Fig. 7, shows a large number of rim plates; the specimen from which his drawing was made, Plate XXXIV, Fig. 8, does not show a large number of small plates near the margin.

Occurrence.—Corryville. The plesiotypes shown on Plate XXXIV, Figs. 9, 11 and 12 are from Fairview Heights, Cincinnati, Ohio. Another plesiotype, shown on Plate XXVII, Fig. 5, was found at the same place by E. H. Vaupel.

Holotype.—No. 1190, A. M. N. H.; *Plesiotypes.*—Nos. 10023, 10024, 10012, C. L. F., 33407, W. M. and 1390, U. C. M.

LICHENOCRINUS CRATERIFORMIS HALL.

Plate XXXII, Figs. 5-12.

Lichenocrinus crateriformis Hall, 20th Rept. N. Y. State Cab. Nat. Hist. (adv. sheets) p. 9, 1866; a reissue of the same, pl. 3, fig. 7. 1871.

Lichenocrinus crateriformis Hall, 24th Rept. N. Y. State Mus. Nat. Hist. p. 217, pl. 7, fig. 7. 1872.

Lichenocrinus crateriformis Meek, Geol. Surv. Ohio, Pal., vol. 1, pt. 2, p. 51, pl. 3, figs. 1a-1t (part). 1873.

Lichenocrinus affinis Miller, Journ. Cincinnati Soc. Nat. Hist., vol. 5, p. 229, pl. 9, figs. 7-7a. 1882.

Lichenocrinus affinis Foerste, Bull. Sci. Lab. Denison Univ., vol. 17, p. 478, pl. 2, fig. 5. 1914.

For additional reference see Bull. 92, U. S. N. M., p. 721.

Description.—Basal body small, depressed convex with a comparatively large crater; crater plates polygonal, somewhat irregular in size and arranged in one or two series. The small pentagonal column occupies about one-third the crater area. The body plates are flat or slightly convex, pentagonal and hexagonal, nearly uniform in size and arranged in alternating series; 2 to 3 plates can be counted along a radius from the crater to the margin. A few small plates are seen at the margin.

Dimensions of the holotype and Miller's type of *L. affinis* and the specimen shown on Plate XXXII, Fig. 9: diameter 5.5, 4.9 and 4.5 mm.; diameter of the crater of each 2 mm.; diameter of the column 0.8, 0.7 and 0.6 mm.

Remarks.—Some variation will be noted among the specimens figured on Plate XXXII, Figs. 5-12. The body plates of Miller's *L. affinis* are somewhat larger than those in the holotype or in either of the two specimens represented by Figs. 7 and 9. Such variations in the size of plates are considered individual, since these specimens agree in all other respects. Similarly the crater plates shown by Fig. 7 are somewhat more irregular in size and are on the whole smaller than those shown by Fig. 6; they are, however, comparable to those seen in Fig. 9.

The horizon of *L. crateriformis* generally has been considered to be the Eden, though Hall states that his type was found at Oxford, Ohio, and the specimen, (Plate XXXII, Fig. 12), is attached to a pedicle valve of *Strophomena planumbona* Hall, thus fixing its horizon as either Waynesville or Liberty. Meek states that this species "ranges through most of the thickness of the Cincinnati group at that place, [Cincinnati], and for fifty or more miles from there in the surrounding country." Bassler in his "Bibliographic Index of American Ordovician and Silurian Fossils" gives the horizon of *L. crateriformis* as Eden.

Meek, in addition to figuring what appear to be typical specimens of *L. crateriformis*, illustrates several specimens

that will probably be found to belong to other forms. One of his plesiotypes has the plates so poorly preserved that identification is uncertain; the column, however, is very well preserved and is here figured, (Plate XXVII, Figs. 7-8), to show its character.

Foerste, in 1914, refigured but did not discuss the two cotypes of *Lichenocrinus affinis* illustrated on Plate XI, Fig. 7, accompanying Miller's original description. These specimens, part of a larger set, are now lost; but Foerste's figures show that they possessed the character of the other extant cotypes, such as the ones illustrated on Plate XXXII, Figs. 5-6, of the present paper. They differ, however, from the enlarged drawing published by Miller, (Plate XI, Fig. 7), which, rather than the actual specimens, appears to be the basis of his description, in having a larger column, larger and more flattened crater and fewer, larger and more regular plates. In all of these characters they conform to the holotype of *L. crateriformis Hall*, of which *L. affinis* Miller, therefore, must be considered a synonym.

Forms that resemble *L. crateriformis* and are allied to it are found in all formations from the Mt. Auburn down through the Eden, the Fulton and even in the Trenton, the most primitive ones appearing in the Decorah, (Black River), of the Mississippi Valley. There are, therefore, many related forms of *L. crateriformis* and they differ from each other according to the formations in which they occur. Many of these I have both from the Cincinnatian and older formations, but in this paper I am not undertaking to describe or figure them, prefering to wait until more material with accurate data has been obtained.

Occurrence.—From the Waynesville to the Elkhorn. Hall's type is from the Waynesville or Liberty at Oxford, Ohio; Miller's types of *L. affinis* are from the Waynesville near Lebanon, Ohio. The specimens shown on Plate XXXII, Figs. 7-8 are from the Waynesville near Pekin, Ohio, and the specimen

represented by Fig. 9 was found by W. H. Shideler in the Elkhorn near Hamburg, Indiana.

Holotype.—No. 1190 a, A. M. N. H.; *Plesiotypes.*—Nos. 8810, W. M., 10044, 10045 C. L. F., and specimen in collection of W. H. Shideler.

LICHENOCRINUS IRREGULARIS N. SP.

Plate XXXII, Fig. 13.

Description.—This form is closely related to *L. crateriformis* Hall but is distinguished from it by the irregularity of the size, shape and arrangement of the body paltes. They range from quadrangular to hexagonal and are arranged in approximately five or six series. The crater is large and deep and is less flattened in the center than is characteristic of *L. crateriformis;* crater plates are of the same type as the body plates and would be arranged in two series. It seems that the column may have had a greater diameter than that of *L. crateriformis.*

Dimensions of the holotype: diameter 5 mm.; diameter of the crater 2 mm.

Occurrence.—Whitewater, Dodge Creek, near Oxford, Ohio.

Holotype.—No. 10046, C. L. F.

LICHENOCRINUS KEMPERI N. SP.

Plate XXXII, Figs. 1-4.

Description.—Basal body highly convex with a deep, steep-sided crater composed of two series of small, smooth plates. The pentagonal column occupies only a small portion of the crater area. The body plates are smooth, flat and meet each other to form a regularly convex surface; they are uniform in size and characteristically hexagonal. There are five to six series of body plates, the rim plates being indistinguishable from them.

Dimensions of the two types: diameter 9 mm. each; height 3 and 2.5 mm.; diameter of the crater 3.5-4 and 2.5 mm.; column — and 1 mm.

Remarks.—The regular, high convexity and the deep crater of *L. kemperi* form a group of characters found in other species of *Lichenocrinus* in my collection, and ranging through the Economy, Southgate and Waynesville. In these respects, however, these species differ strikingly from *L. kemperi.*

This species is named in honor of my friend, Willis M. Kemper, who has collected Cincinnatian fossils for many years.

Occurrence.—Elkhorn, about seven feet above the strata bearing *L. tuberculatus* Miller and *L. milleri* n. sp. The types were found in Seven Mile Creek, two and one-half miles south of Eaton, Ohio. The specimen shown on Plate XXXII, Fig. 1, was found by Dr. W. H. Shideler and presented to me.

Holotype.—No. 10040; *Paratype.*—No. 10041, C. L. F.

LICHENOCRINUS TUBERCULATUS MILLER.

Plate XXXIII, Figs. 1-2.

Lichenocrinus tuberculatus Miller, Cincinnati Quart. Journ. Sci., vol. 1, p. 346, fig. 38. 1874.

Lichenocrinus tuberculatus Miller, Journ. Cincinnati Soc. Nat. Hist., vol. 5, p. 229, pl. 9, figs. 6-6a. 1882.

Description.—"Body discoidal, circular in outline; lower surface or surface of attachment, flat, or conforming to the surface to which it is attached; upper surface strongly convex or subhemispheric, with a deep circular depression in the central part, around the column; upper surface of body composed of numerous, irregularly arranged, thin, pentagonal or hexagonal plates, nearly uniform in size, smooth on the under side and highly convex or tuberculated on the outer surface. Excluding the plates immediately surrounding the column, within the central depression, which are much smaller than the others, the remainder will number about one hundred. Interior filled with upright lamelliform plates, radiating from a central point, on which the exterior plates appear to repose. Column pentagonal, length unknown.

. . . . . .

"It is distinguished from *L. crateriformis*, which species it most resembles, by its tuberculated plates. It differs, too, in its greater convexity, more abrupt central depression, and greater uniformity in the size of its plates.

". . . . . Small specimens, very closely resembling this species in general outline, are found near Clarksville, in Clinton county, Ohio, but differing, in the specimens examined, in this important regard, that the plates appear to be smooth instead of tuberculated." (Miller.)

Basal body, usually highly convex, crater comparatively small and shallow to moderately deep. Crater plates, smooth, flat, polygonal, irregular in size and shape; they are arranged in two series, the one nearest the column being composed of smaller plates than the other. The pentagonal column, occupying about half the entire crater area, is composed of thin alternating plates, five of which form a columnal. The body plates are numerous, 5-6 in the space of 3 mm. in Miller's type and 6-7 in the space of 5 mm. in the plesiotype figured on Plate XXXIII, Fig. 1, the latter being the larger of the two specimens. In individual specimens they are nearly uniform in size from the crater to the margin and range from quadrangular to octagonal, though generally from pentagonal to hexagonal; five to six plates can be counted along a radius from the crater to the margin. The plates bear low rounded to high conical tubercles, in some cases surrounded by incised lines parallel to the margins of the plates. Miller's cotype, a free specimen, has two series of rim plates; the arch plate is revealed near the margin where several body plates are removed. The arch plate is best shown on Plate XXVIII, Figs. 1-2.

The dimensions of Miller's type and the plesiotype figured on Plate XXXIII, Fig. 1: diameter 6.4 and 9.4 mm.; diameter of the crater 1.9 and 2.5 mm.; diameter of the column 1 and 1.5 mm.

Remarks.—In Miller's set of cotypes of *L. tuberculatus* were specimens belonging to the new forms of *L. milleri* and

L. shideleri; his plesiotype is here considered under *L. nodosus.* Miller apparently did not make the distinction between the three types of tuberculated plates, though such separation seems desirable.

Occurrence.—Waynesville to Elkhorn. Miller's cotypes and the plesiotype figured on Plate XXVIII, Fig. 1, are from Hill's Mills, near Richmond, Indiana; plesiotypes figured on Plate XXVIII, Fig. 14 and Plate XXXIII, Fig. 1 were found near Richmond, Indiana; an unfigured plesiotype is from Seven Mile Creek, near Eaton, Ohio.

Cotypes.—Nos. 3877, 3978 and 3983, U. C. M.; *Plesiotypes.* —Nos. 10014, 10050, C. L. F. and 21034, W. M.

Except those mentioned in the preceding paragraph, Miller's cotypes of *L. tuberculatus* have been found to belong to other forms: Nos. 3878 and 1388, U. C. M., to *L. milleri;* 1387, U. C. M., to *L. shideleri regularis.* Miller's plesiotype No. 8826, W. M., is a paratype of *L. nodosus.*

LICHENOCRINUS MILLERI N. SP.

Plate XXXIII, Figs. 3-9.

Description.—Basal body depressed convex; crater characteristically large and deep and covered by smooth, thick quadrangular to hexagonal plates of which there probably are two series between the body plates and the column. The pentagonal column occupies about half of the crater area. The body plates are thick pentagonal to octagonal with occasional small quadrangular ones. There are 3-4 plates in the space of 5 mm. and 3-4 may be counted along a radius from the crater to rim plates. These plates are ornamented by incised lines paralleling the margins and a high rounded or angular tubercle in the center. The outline of the body varies according to the addition of the rim plates of which there may be one series or irregularly arranged groups; the upper left hand margin of Fig. 3, Plate XXXIII shows such a group. Not infrequently these most recently added plates bear highly angular or rounded tubercles. Free specimens show floor plates and 1 to 2 series of inferior rim plates.

Dimensions of the holotype and the paratype No. 10030: diameter 14.7 and 12 mm.; diameter of the crater 4 and 3.7 mm.; diameter of the column 2.3 and — m.

Remarks.—This form is closely related to *L. tuberculatus* but is distinguished from it by the large, highly tuberculated body plates and the numerous irregularly arranged rim plates. One of Miller's cotypes of *L. tuberculatus* is here figured as a paratype of *L. milleri.* The two forms of *L. tuberculatus* and *L. milleri* are very closely related and may possibly intergrade; at one locality, Seven Mile Creek, near Eaton, Ohio, they are associated in the same strata with *Lepadocystis moori* (Meek). This species is named in honor of S. A. Miller.

Occurrence.—Elkhorn. The holotype was found near Versailles, Indiana; the paratype shown on Plate XXXIII, Fig. 6 was found at Lytle, near Lebanon, Ohio; the specimen shown in Fig. 7 was found three miles south of Osgood, Indiana, and the one in Fig. 8, at Hill's Mills, near Richmond, Indiana.

Holotype.—No. 10029; *Paratypes.*—Nos. 10021, 10030, 10047, C. L. F. and 3878, U. C. M.

LICHENOCRINUS NODOSUS N. SP.

Plate XXXIII, Figs. 10-12.

Description.—Depressed convex with a large crater, only a small portion of which is occupied by the pentagonal column. The crater plates are elongate, generally smooth, pentagonal to heptagonal and arranged in one series; two of the partypes have 9 and 12 respectively. Distally the crater plates become broader than at the base of the crater and alternate with the nodose body plates; this arrangement is well shown on Plate XXXIII, Fig. 12; most of the crater plates are lost in the holotype. The body plates are arranged in 2 to 4 alternating series; those forming the first series are pentagonal and hexagonal with one node or tubercle rising from the margin of each plate. Those of the outer series are elongate, irregular in size and outline and convex or tuberculate; these plates are well shown by the figures. The lamellae

are highly arched and the body plates rest directly on them.

Dimensions of the holotype and largest paratype: diameter 8.5 and 11.3 mm.; diameter of the crater 4 and 4.6 mm.; diameter of the column — and 1 mm.; maximum height 2.3 and 2.9 mm.

Remarks.—The group of three specimens, here figured as paratypes, were used by Miller in his redescription of *L. tuberculatus;* they possess the elongate crater plates and elongate marginal plates which characterize *L. nodosus.*

Occurrence.—Waynesville to Elkhorn; the holotype is from the Waynesville near Weisburg and the paratypes are from the Elkhorn, three miles south of Osgood, Indiana.

Holotype.—No. 10032, C. L. F.; *Paratypes.*—No. 8826, W. M.

LICHENOCRINUS SHIDELERI N. SP.

Plate XXVIII, Fig. 9; Plate XXXIV, Figs. 3-4.

Description.—Basal body irregular in outline and very slightly convex; crater deep in proportion to the total height of the specimen. Pentagonal column occupies about half of the crater area; the crater plates appear to be of the same character as the body plates and arranged in one series. Body plates quadrangular to octagonal, angles slightly rounded, irregular in size and with no definite arrangement. Small plates, usually quadrangular, appear irregularly between the larger body plates. The body plates are highly convex or tuberculated, incised lines paralleling the margins mark a few of the plates, particularly in the paratype; incised concentric lines ornament some of the tuberculated plates. The holotype has 7 plates in the space of 5 mm. while the paratype has from 6 to 8 in the same space. Five to 7 plates can be counted along a radius from the crater to the margin. The body plates are the same to the margin except that the most recently added are smaller than the others.

The floor plates of the types, free specimens, are either smooth or bear the markings of the host.

The dimensions of the holotype and the paratype: diam-

eter 10.5 and 10.3 mm.; diameter of the crater 3.6 and c 4 mm.; diameter of the column 1.9 and — mm.; height including the floor plate 2.2 and 2.6 mm.

Remarks.—This form is closely related to *L. tuberculatus* from which it differs in being less convex and more irregular in outline. The body plates of *L. shideleri* are less angular, more irregular in size, and their tubercles are more conical than those of *L. tuberculatus*.

This species is named in honor of Dr. W. H. Shideler of Miami University who found and presented the types, as well as the specimen shown on Plate XXVIII, Fig. 4, which is probably *L. shideleri*.

Occurrence.—Saluda, near Mixerville, Indiana; it occurs also in the Elkhorn.

Holotype.—No. 10026; *Paratype.*—No. 10028, C. L. F.

LICHENOCRINUS SHIDELERI REGULARIS N. VAR.

Plate XXVIII, Fig. 8; Plate XXXIV, Figs. 1-2.

Description.—Basal body depressed, slightly convex; crater large and deep in proportion to the convexity, the pentagonal column occupying about half the area. The crater plates appear to be smaller than, but of the same character as, the body plates; they are probably arranged in two series, matrix covers most of the plates in the holotype. The body plates are quadrangular to octagonal, quite regular in size though a very few small plates are found between the large ones. The plates are not sharply angular and are convex to tuberculate though the tubercles are low and rounded. Incised circular lines mark some of the plates. Three to 6 plates can be counted along a radius from the crater to the margin. Rim plates are small and convex; they are irregularly arranged in one or two series or grouped together. One series of inferior rim plates can be seen on free specimens; these small plates are in one continuous series or alternate with the next series of slightly larger plates. The holotype is free and the floor plate, shown on Plate XXVIII, Fig. 8, is comparatively smooth.

Remarks.—This form differs from *L. shideleri* in having larger and more regular plates with lower and less conical tubercles. With this variety is also considered, though not in the above description, the specimen shown on Plate XXXIV, Fig. 2. This individual is larger than the holotype with flatter plates, marked by incised lines, in a depression surrounding the normal crater area. .

Occurrence.—Elkhorn; the holotype is from near Richmon, Indiana, and the paratype is from south of Osgood, Indiana.

Holotype.—No. 10027; *Paratype.*—No. 10025, C. L. F.

GENUS XENOBASIS NOV.

Genotype: *Xenobasis williamsi* n. sp.

Description.—Basal body suggests *Lichenocrinus* in general shape. Column large, round or subpentagonal composed of thin abutting plates, five to each columnal. Body plates numerous, polygonal or subpolygonal; they decrease in size toward the margins, though large plates do occur far from the crater. Between the body plates are small, subpolygonal plates whose distribution in the genotype is described under that species.

Remarks.—The basal body of *X. williamsi* bears some resemblance to that of *Cleiocrinus grandis* Billings, (Canadian Organic Remains, decade 4, p. 54, pl. 5, figs. 2a-c, 1859). The growth of columns in that species, however, resembles that of *Anomlocrinus* and some other crinoids whose bases are found in Cincinnati strata. The column of *Cleiocrinus* is markedly pentagonal and contains a very large, round canal, quite unlike that in *X. williamsi* nor does the base of *Cleiocrinus* possess the rows of minute plates which characterize the present genus.

XENOBASIS WILLIAMSI N. SP.

Plate XXXV, Figs. 1-3.

Description.—Basal body robust, convex, irregular in outline, with lobate extensions marginally. Crater large and

steep-sided; the crater plates are small but are mainly hidden by the large, semi-round column which occupies nearly the entire area. The surface of the column is ornamented by small nodes, 7 to 8 of which occupy the space of 2 mm. Body plates smooth, flat, irregularly polygonal, large to small; 12 to 16 may be counted along a radius. Between the larger body plates are rows of minute, subpolygonal plates; marginally these rows become broken, and isolated minute plates may be found.

Dimensions of the holotype: maximum radius, (from center of column), 14.5 mm.; diameter of crater 7 mm.; diameter of column 5.7 mm.

Remarks.—This specimen is attached to the irregular surface of a rock formed of fragments of bryozoans, crinoid columns, brachiopods and matrix.

This species is named in honor of S. R. Williams of Miami University by whom the holotype was found.

Occurrence.—Liberty, Dodge Creek, near Oxford, Ohio.

Holotype.—Collection of S. R. Williams.

GENUS CYSTOIDOSACCUS NOV.

Genotype: *Cystoidosaccus fultoni* n. sp.

Description.—Basal body resembles *Lichenocrinus* in general shape but is larger, less regular in outline and strongly lobate. Crater plates small; body plates small to large, irregularly and variably polygonal, without definite arrangement.

The distinctive character of the genus is a large opening which, in the genotype, is situated eccentrically, near the margin; about it is a depressed, flattened area paved with plates smaller than the body plates but variable in size. The opening itself, in the one specimen known, is diamond-shaped and quadrangular bounded by ridges composed, so far as can be seen, of two rows of small plates; outwardly, the ridges are continuous with the surface of the depressed area.

CYSTOIDOSACCUS FULTONI N. SP.

Plate XXXV, Figs. 4-5.

Description.—Basal body large, irregularly convex, lobate. Column robust, subpentagonal, occupying most of the crater area. Crater plates smaller than the body plates, but not otherwise distinguished from them. Body plates numerous, small to large, irregularly polygonal, pentagons and hexagons being the most common; their surfaces are depressed convex. There is no definite pattern of plate arrangement, though something resembling the rosette of plates in the right-hand lobe, (Plate XXXV, Fig. 4), may be seen on other parts of the body.

The general characters of the diamond-shaped opening have been mentioned in the description of the genus. The plates composing the depressed area are variable in size, those at either end being nearly as large as the adjoining body plate, while those above and below it are very small. The ridges immediately bounding the opening also are composed of two rows of small plates, generally hexagonal, which merge outwardly with those of the depressed area. At the upper and lower angles of the opening a deep groove separates the adjoining ridges.

Dimensions of the holotype: maximum diameter 22 mm.; maximum diameter of crater 7 mm.; diameter of column c 5 mm.

Remarks.—The holotype is attached to the uneven surface of a specimen of *Stromatocerium huronense* (Billings). The column was in place when the specimen was found; it was large, subpentagonal and resembled the typical columns of *Lichenocrinus*. During the removal from the rock, however, the column was lost, so that no detailed description of it can be given.

The species is named in honor of my friend, Robert S. Fulton, whose collection is preserved in Western College at Oxford, Ohio.

Occurrence.—Tetradium—Stromatocerium reef of the Up-

per Elkhorn, Elkhorn Creek, Indiana, in N E one-fourth, Sec. 29, T. 13 N., R. 1 W. (Foerste's locality No. 8.)

Holotype.—No. 10042, C. L. F.

EXPLANATION OF PLATES.

NOTE.

Unless otherwise stated, the figures are magnified two *diameters;* all other magnifications or reductions are also indicated in terms of diameters. The abbreviations used in the plate explanations are the same as those used in the text and will be found on page 454.

PLATE XXVII.

FIGURE — PAGE

1. Unattached column from the McMicken member ---- 457
   A specimen representing the round type of column composed of unequal plates. (10008 C. L. F.)
2—3. Unattached columns from the McMicken member ---- 457
   These represent the round and gradually tapering type of column. (10009 and 10010 C. L. F.)
4. Undescribed form from the Southgate member ---- 457
   This figure shows an abrupt change in the size of the pentagonal column, beyond which it gradually becomes round. (10011 C. L. F.)
5. *Lichenocrinus dyeri* Hall ---- 457
   This specimen shows a heavy round column gradually tapering. (10012 C. L. F.)
6. Undescribed form from the Southgate ---- 457
   A specimen with a pentagonal column gradually becoming round. (9573 W. M.)
7—8. *Lichenocrinus* sp. from the Eden ---- 457
7. Meek's plesiotype of *L. crateriformis* Hall. This specimen is attached to a *Dalmanella;* it has a pentagonal column gradually becoming round. (986 W. M.) x 1.
8. Portion of the same enlarged. x 2.

PLATE XXVIII.

FIGURE PAGE

1—3. *Lichenocrinus tuberculatus* Miller 457

1. A weathered specimen with some of body plates removed showing the arch plate. (10014 C. L. F.)
2. The same enlarged. Outlines of some of the body plates can be seen on the arch plate. The peripheral edge of the arch and floor plates can also be seen. x 5.
3. Unattached specimen showing a relatively smooth floor plate and a portion of the lower surface of the arch plate, (at the right side of the figure.) (10015 C. L. F.)

4. *Lichenocrinus* cf. *shideleri* n. sp. 457
Four individuals crowded together, showing the primary and secondary lamellae and the nodes. Elkhorn, Osgood Pike, one mile from Versailles,Indiana. (10049 C. L. F.)

5. *Lichenocrinus sp.* 457
This has fewer primary and secondary lamellae than the specimen shown in Fig. 4. Waynesville, near Weisburg, Indiana. (10018 C. L. F.)

6. *Lichenocrinus tuberculatus* Miller 457
This shows many primary and secondary lamellae with traces of the former upon the node. Elkhorn, two and one-half miles south of Eaton, Ohio. (10019 C. L. F.)

7. *Lichenocrinus* sp. 457
This specimen has rather heavy lamellae and, therefore, not as many as are shown by Fig. 6. Waynesville, near Pekin, Ohio. (10017 C. L. F.)

8. *Lichenocrinus shideleri regularis* n. sp. 457
Unattached specimen showing a smooth floor plate with a distinct demarcation between it and the inferior rim plates. Top view shown on Plate XXXIV, Fig. 1. (10027 C. L. F.) x 1.25.

9. *Lichenocrinus shideleri* n. sp. 459
This figure shows a floor plate bearing the markings of its host, a *Strophomena*. Inferior rim plates can be seen as well as the eccentric node. Top view on Plate XXXIV, Fig. 4. (10026 C. L. F.)

10—11. *Lichenocrinus tuberculatus* Miller 459
The regular ring of plates near the margin represents one stage in the growth of this individual. The rim plates extend from this ring to the floor plate. Elkhorn, near Lytle, Ohio. (10020 C. L. F.)

FIGURE PAGE

11. Under surface of the same showing the floor plate bearing markings of its host, a *Pterinea*.

12—13. *Lichenocrinus* sp. ---- 459

12. Thirty-two young individuals attached to a bryozoan; a few specimens have distinguishable body plates but specific characters are not developed at such an early stage. Waynesville, near Pekin, Ohio. (10022 C. L. F.) x 1.

13. Nineteen young specimens attached to *Strophomena nutans* Meek. A few have distinguishable plates. Liberty, Four Mile Creek, near Oxford, Ohio; found and presented by Dr. W. H. Shideler. (10043 C. L. F.)

14. *Lichenocrinus tuberculatus* Miller ---- 460
This shows a specimen conforming to the surface of its host. The *L. tuberculatus* has its greatest diameter parallel to the fold of the *Platystrophia*. (21034 W. M.)

PLATE XXIX.

FIGURE PAGE

1. *Lichenocrinus fentonae* n. sp. ---- 460
Thirteen individuals of *L. fentonae* crowded together on a nodule; associated with them are several crinoid bases and specimens of *Hemicystites*. (10991 W. M.) x .6.

2. *Lichenocrinus dubius* Miller ---- 459
This shows a specimen attached to and encircling a crinoid column. (10037 C. L. F.)

3—4. *Lichenocrinus tuberculatus* Miller ---- 459
These specimens have grown around the slender zooaria of *Bythopora delicatula* (Nicholson). (10035, 10036 C. L. F.)

5. *Lichenocrinus* sp. ---- 457
This specimen has its floor plate folded as though it had grown over the edge of a very delicate host, no trace of which is preserved. (10038 C. L. F.)

6—8. *Lichenocrinus tuberculatus* Miller ---- 460

6. Two abnormal individuals with two columns and two craters each. (10034 C. L. F.)

FIGURE PAGE

7. Top view showing the apparently eccentric position of the column; the outlines of the plates are slightly obscured by *Corynotrypa inflata* (Hall). (10039 C.L.F.)

8. Same specimen showing the large number of small plates on the portion of the individual that grew either in a folded position on its floor plate or over the surface of some host. After the death of the *Lichenocrinus*, *Corynotrypa inflata* (Hall) encrusted the upper and lower surfaces.

9. *Lichenocrinus dubius* Miller 460
Two specimens attached to a nodule; they have grown down into the grooves. (989 W. M.) x 1.

PLATE XXX.

FIGURE PAGE

1—3. *Lichenocrinus dubius* Miller 464

1. Two specimens that are shown attached to a nodule on Plate XXIX, Fig. 9. This figure shows the crater plates and the isolated elevations. (989 W. M.)

2. Another specimen showing the crater and body plates. (3875 U. C. M.)

3. Holotype showing the character of the column and the irregularity of the basal body, only a few plates of which can be distinguished. (8783 W. M.)

4—5. *Lichenocrinus stetteri* n. sp. 466

4. Holotype showing the crater surrounded by the irregular, isolated elevations. (10007 C. L. F.)

5. Enlargement of the same showing the large flat crater plates, the many irregular body plates and the isolated elevations.

6. *Lichenocrinus pattersoni* Miller 461
Holotype showing the numerous irregular body plates and a portion of the column in place. (8842 W. M.)

7—8. *Lichenocrinus fentonae* n. sp. 462

7. One of the cotypes that is shown at the lower right hand side of Fig. 8. This shows the body plates arranged in concentric series. (10991 W. M.)

8. A group of individuals, (cotypes), crowded together on a nodule. See Plate XXIX, Fig. 1. (10991 W. M.)

PLATE XXXI.

FIGURE PAGE

1—3. *Lichenocrinus schlemmeri* n. sp.----466

1—2. Two views of the same specimen showing several individuals attached to a crinoid column. (10006 C. L. F.)

3. Holotype showing the shape of the basal body and the character of the plates. (10005 C. L. F.)

4—5. *Lichenocrinus vaupeli* n. sp.----467

4. Holotype enlarged to show the large, ornamented body plates and the smooth crater plates. (10004 C. L. F.) x 5.

5. Top view of the same showing that it is attached to a bryozoan. x 2.

6—10. *Lichenocrinus twitchelli* n. sp.----463

6. A paratype showing the arrangement of the body plates. (10003 C. L. F.) x 5.

7. A small individual with convex plates and pentagonal column. (10013 C. L. F.)

8. A small individual attached to a bryozoan. (10002 C. L. F.)

9. Showing the holotype attached to *Ceramoporella ohioensis* (Nicholson). The apparent overlapping of the plates is due to the collapse of the specimen. (10001 C. L. F.)

10. Enlarged view of the same showing the nearly uniform size and other characters of the plates. x 4.75.

PLATE XXXII.

FIGURE PAGE

1—4. *Lichenocrinus kemperi* n. sp.----473

1. Top view showing the nearly uniform body plates and the deep crater. (10040 C. L. F.)

2. Side view of the same showing the uniformly high convexity of the basal body.

3. Top view of another specimen. (10041 C. L. F.)

4. Side view of the same showing the convexity.

5—12. *Lichenocrinus crateriformis* Hall----470

5. Cotypes, (not figured by Miller), of *L. affinis* Miller (8810 W. M.)

6. Enlargement of the larger specimen shown in Fig. 5. This figure shows the large body plates arranged in series. x 5.

FIGURE PAGE

7. Top view showing the large crater with two rows of crater plates. (10044 C. L. F.) x 5.
8. Top view of another specimen. (10045 C. L. F.)
9. Top view showing clearly the character and arrangement of the plates. (W. H. S.) x 5.
10. Hall's figure of *L. crateriformis*, presumably representing the specimen shown by Figs. 11 and 12.
11. Hall's type of *L. crateriformis*. (1190 a A. M. N. H.) x 5.
12. The same showing it attached to a *Strophomena*. x 1.
13. *Lichenocrinus irregularis* n. sp.----473
Holotype showing the irregular body plates. (10046 C. L. F.) x 5.

PLATE XXXIII.

FIGURE PAGE

1—2. *Lichenocrinus tuberculatus* Miller----474

1. Top view of a specimen larger than the one shown in Fig. 2. This figure shows the high convexity of the basal body and the regular, highly convex to tuberculated body plates. (10031 C. L. F.)
2. Miller's cotype and first figured specimen showing the high convexity of the basal body and the deep crater. (3877 U. C. M.)

3—9. *Lichenocrinus milleri* n. sp.----476

3—5. Top, lateral and oblique views of the holotype showing the character of the plates, the deep crater and convexity of the basal body. (10029 C. L. F.)
6. Top view of a paratype showing the irregular outline, the deep crater and the perforate column. (10021 C. L. F.)
7. Top view of another specimen, attached to a *Hebertella*. This specimen is slightly weathered so the tubercules of the plates are not very distinct. (10030 C. L. F.)
8. Top view of one of Miller's cotypes of *L. tuberculatus*. This specimen is highly convex and has tuberculated plates. The primary lamellae and the node can be seen in the central area. This specimen is attached to the irregular surface formed of branched bryozoans and *Zygospira*. (3878 U. C. M.)
9. A section showing the floor plates with its node, the arrangement of the body and crater plates and the column resting on the latter. (100047 C. L. F.) x 3.5.

FIGURE PAGE
10—12. *Lichenocrinus nodosus* n. sp. 477
10—11. Lateral and top views of the holotype showing the large nodose plates, the elongate peripheral plates and the depth of the crater. (10032 C. L. F.)
12. Three cotypes showing the deep crater, the elongate crater plates, the nodose body plates and the large elongate marginal plates. (8826 W. M.)

PLATE XXXIV.

FIGURE PAGE
1—2. *Lichenocrinus shideleri regularis* n. var. 479
1. Top view of the holotype showing the regular, convex body plates arranged in circular series. (10027 C. L. F.)
2. Top view of a larger specimen that is not typical of this variety. (10025 C. L. F.)
3—4. *Lichenocrinus shideleri* n. sp. 478
3. Top view of a paratype with an irregular outline and convex plates. (10028 C. L. F.)
4. Top view of the holotype showing the numerous tuberculated plates. (10026 C. L. F.)
5—6. *Lichenocrinus ashmanni* n. sp. 468
5. Top view of the holotype showing the angular subquadrangular ridge and the pointed elevations on the plates forming it. (10016 C. L. F.)
6. Basal surface of the same showing the floor plate and the inferior surface of the series of heavy body plates forming the ridge of the opposite side.
7—12. *Lichenocrinus dyeri* Hall 469
7. Hall's figure, presumably representing the specimen shown in Fig. 8.
8. Hall's type showing the irregularity of the body plates and the large column. (1190 A. M. N. H.) x 5.
9. Inferior surface of the body plates on which are traces of the lamellae. (10024 C. L. F.)
10. Section drawn from larger broken edge of specimen shown in Fig. 9. x 3.5.
11. Top view showing the numerous irregular plates and the large column. (34407 W. M.)
12. A small specimen attached to a *Rafinesquina*. (10023 C. L. F.) x 5.

PLATE XXXV.

FIGURE PAGE

1—3. *Xenobasis williamsi* n. sp. 480

1. Side view showing the general shape and the column composed of thin nodose plates which abut. (S. R. W.)

2. Top view showing the general shape and the sub-pentagonal perforate column.

3. An enlarged view showing the numerous polygonal body plates decerasing in size toward the rim and the minute polygonal plates between them. In some areas the small plates have been lost, thus giving the appearance of wide sutures. x 5.

4—5. *Cystoidosaccus fultoni* n. sp. 482

4. Upper surface showing the general shape and the unequal subpolygonal plates. (10042 C. L. F.)

5. Enlargement of the diamond-shaped opening seen near the lower margin of Fig. 4. x 4.75.

THE SUPPOSED CALYX OF LICHENOCRINUS.[1]

MILDRED ADAMS FENTON.

The name *Lichenocrinus* was proposed by Hall in 1866 for the problematic parasitic organisms so common in the Cincinnatian and Richmond. At that time the exact nature of *Lichenocrinus* was not known as Hall considered the appendage homologous with the ventral tube of some crinoids; later, however, he believed it to be a column. In 1871 Meek suggested that the discs were peculiar attachments of some crinoid whose calyces had not been associated with the bases. C. L. Faber states[2] that, in 1898, he, G. Ashmann and A. Albers found complete specimens—base, column and calyx—in the Economy at Plaineville, Ohio; these specimens, unfortunately are lost so their exact nature is unknown.

Dr. G. M. Austin[3] of Wilmington, Ohio, however, found also in 1898, specimens of *Lichenocrinus*[4] associated with calcyces in the Upper Blanchester, one-half mile up Cowan Creek from the Wilmington and Clarksville Pike, near Clarksville, Ohio. He concluded that the calyces (Plate XXXVI, Figs. 1-3) belonged to the basal attachments of *Lichenocrinus* with which they were associated, (Plate XXXVI, Figs. 5-7); this association he considered to be so close as to leave no doubt of the connection, even though no specimen was complete from base to calyx.

Let us now turn to a consideration of Dr. Austin's material that is here figured. There are eight specimens of *Lichenocrinus* attached to the surface of a rather coarsely striated *Rafinesquina*, (Plate XXXVI, Fig. 5), and three

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[1] Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 9.

[2] This Journal, vol. 11, p. 455, 1929.

[3] Austin Proc. U. S. Nat. Mus. No. 2671, vol. 70, art. 22, pp. 1-18, 1927.

[4] Bassler, Bull. Geol. Soc. Am., vol. 39, No. 1, p. 298, 1928.

fragments of very delicate unmistakable *Lichenocrinus* column in the matrix beyond the margin of the shell. Attached to a fragment of *Isotelus*, (Plate XXXVI, Fig. 6), are four bases. On a bryozoan, (not figured), are two small, very poorly preserved bases. On still another piece of bryozoan, (Plate XXXVI, Fig. 7), are found six small bases and two fragments of *Lichenocrinus* column; several other fragments are found in the matrix beyond the bryozoan, the largest one can be seen to the right of the bryozoan in Figure 7.

A small calyx attached to a *Zygospira*, (Plate XXXVI, Fig. 3), is shown in what appears to be its original position in the slab, (Plate XXXVI, Fig. 7). If this is correct then the column lying on the bryozoan must have originally rested in the depression on the bryozoan and been attached to the calyx. The calyces, (Plate XXXVI, Figs. 1-3), do not have enough of the columns preserved to show their character.

The identification of the calyces, beyond their *Heterocrinoid* relationships, is impossible because the specimens are very small and the outlines of the plates can be seen in only a few cases. A calyx, (Plate XXXVI, Fig. 4), from the Black River at St. Paul, Minnesota, seems to be similar to those shown in Figures 1-3. Since the formation, Black River (Platteville), contains *Lichenocrinus* the probability that it represents this genus is increased.[5] The bases (Plate XXXVI, Figs. 5-7) all appear to be of the same type; Dr. Austin states that they are *Lichenocrinus affinis* Miller which, according to C. L. Faber[6], is a synonym of *L. crateriformis* Hall.

Thus the evidence at hand, together with Dr. Austin's account of their occurrence, leads one to consider that the calyces belong to the bases with which they are so closely associated since the only other crinoidal material noted was one columnal of *Heterocrinus juvenis* Hall, 5.8 mm. in diameter and therefore too large to belong to the calyces here considered.

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[5] This Journal, vol. 11, pp. 494-499, 1929.

[6] This Journal, vol. 11, p. 470, 1929.

EXPLANATION OF PLATE XXXVI.

(Specimens in the U. S. Nat. Museum)

FIGURES

1—3. Calyces of a *Heterocrinoid* associated with *Lichenocrinus crateriformis.*

1—2. Opposite sides of two different specimens. x 5.

3. Another calyx attached to a *Zygospira.* This is also shown in Fig. 7. x 5.

4. A similar type of calyx from the Black River at St. Paul, Minn. (No. 42, 115.). x 5.

5. Eight specimens of *Lichenocrinus* attached to a *Rafinesquina.* A fragment of *Lichenocrinus* column can be seen in the upper left hand corner (where the shell is broken); there are two fragments at the lower left, (these are so small they can scarcely be seen). x 1.

6. Four specimens of *Lichenocrinus* attached to a fragment of *Isotelus.* x 2.

7. Slab showing five specimens of *Lichenocrinus,* (a sixth is obscured), attached to a bryozoans. At the left center is the calyx shown in Fig. 3; this seems to have been its original position. Fragments of columns can be seen on the bryozoan and in the matrix to the right and lower left of it. x 2.

NOTES ON SEVERAL FORMS OF LICHENOCRINUS FROM BLACK RIVER FORMATIONS.[1]

MILDRED ADAMS FENTON.

In comparing some specimens of *Lichenocrinus* from the Black River of the Mississippi Valley with others from the Cincinnatian and Richmond some interesting relationships are noted. Several Black River forms appear to be ancestral to Richmond species while one is related to a Mt. Hope form. On the whole the specimens are much smaller than those from the Richmond and the characters are, therefore, less distinct. One specimen, here described as *L. ornatus*, is comparable in size to the average Cincinnatian or Richmond forms and appears to be related to a Waynesville species. Comparisons are rendered difficult, however, by the fact that only a small number of the Black River specimens can be used as some are too small to show distinctive characters and others are so poorly preserved that their characters are lost. Additional *Lichenocrinus* material will, no doubt, show still other relationships of Black River and Richmond forms.

LICHENOCRINUS NODOSUS MINNESOTENSIS N. VAR.

Plate XXXVII, Fig. 1.

Description.—This form has a relatively high convexity with a wide deep crater. The plates immediately surrounding the delicate column are obscured by matrix but those on the crater slopes are comparatively large and are arranged in one circular series. The series of the body plates nearest the crater area are of about the same size as those within it; they are convex with low rounded elevations and a few bear incised lines paralleling the margins; the plates at the periphery are larger and very irregular in outline. A few small plates appear between these two series.

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[1] Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 10.

The dimensions of the holotype are: diameter 4 mm.; diameter of the crater 1.5 mm.; diameter of the column 0.5 mm.

Remarks.—This form, characterized by large peripheral plates, seems to be related to *L. nodosus*[2] C. L. Faber, from which it differs in the lack of the elongate crater plates and pronounced nodose body plates. Though these latter are important characters of *L. nodosus* a relationship between the two forms seems to be indicated by the elongate peripheral plates. A larger specimen might show an even closer relationship.

Occurrence.—Black River, St. Paul, Minnesota.

Holotype.—U. S. N. M.

LICHENOCRINUS NODOSUS AFF. MINNESOTENSIS N. VAR.

Plate XXXVII, Figs. 2-3.

Remarks.—The two specimens shown in Figures 2 and 3 are small and do not have their plates clearly demarked. The former, Plate XXXVII, Fig. 2, is from the same locality as the holotype of *L. nodosus minnesotensis*, and while it does not appear to be identical with that form, it certainly shows a close relationship. The other specimen, Plate XXXVII, Fig. 3, is distorted in growth but shows a few large plates near the margin.

Occurrence.—The specimen shown in Figure 3 is from the Beloit at Minneapolis, Minnesota, and the other specimen may be from the same horizon. It is from St. Paul, Minnesota.

Figured specimens.—U. S. N. M.; No. 881, U. C. M.

LICHENOCRINUS AUSTINI N. SP.

Plate XXXVII, Fig. 4.

Description.—All the plates of this specimen appear to be of approximately uniform size; some are convex and others

[2] This Journal, vol. 11, p. 477, 1929.

are flat, though this is probably a result of weathering. The column is entirely broken away. The diameter is 7 mm.

Remarks.—Though this specimen is not well preserved its characters appear to be distinct.

Occurrence.—Black River, St. Paul, Minnesota.

Holotype.—U. S. N. M.

LICHENOCRINUS AFF. CRATERIFORMIS HALL.

Plate XXXVII, Figs. 5-8.

Remarks.—The specimens here considered are closely related to *Lichenocrinus crateriformis* Hall, from the Richmond. Of the four figured specimens, two are from Dixon, Illinois, one from Cannon Falls, Minnesota, and the fourth from Minneapolis, Minnesota; their respective maximum diameters are: 5.6, 3.8, 5 and 6 mm. These are approximately the same size as average specimens of *L. crateriformis.* While these Black River forms no not have such pronounced craters nor such clearly demarked plates their general character is similar to that of *L. crateriformis.*

Occurrence.—Black River; specimens from Dixon, Illinois, Cannon Falls and Minneapolis, Minnesota.

Figured specimens.—U. S. N. M.; (one shown on Plate XXXVII, Fig. 7) No. 875 U. C. M.

LICHENOCRINUS ORNATUS N. SP.

Plate XXXVII, Fig. 9.

Description.—The crater is small and only moderately deep, about a third of it is occupied by a quinquepartite column, a small portion of which is in place. The plates immediately around the column are indistinct; one circular series of paltes alternating with the body plates forms the wall of the carter. These plates usually have three sides peripherally and the other portion of the plates that turn downward to form the wall of the crater are not clearly demarked. The large body plates (two to three circular series) are irregularly polygonal with from four to eight angles; they range in diam-

etre from 1.3 to 2 mm. and have their maximum diameter along the radii of the specimen. Each of these plates bears a low rounded elevation and deeply incised lines paralleling the margins; the latter probably represent successive growth stages. Between these ornate plates and the margin are small polygonal plates of the same general character as the large ones but less ornamented; a few plates have a pronounced convexity and others bear incised lines. The irregular outline of this specimen is due to the irregular arrangement of these marginal plates.

Measurements: maximum diameter 9.3 mm.; diameter of the crater 2.7 mm.; diameter of the column 1 mm.

Remarks.—*Lichenocrinus ornatus* resembles *L. milleri*[3] C. L. Faber in general appearance. The former lacks, however, the highly tuberculated body plates and seems to have a larger proportion of small plates near the periphery. *L. ornatus* is smaller than *L. milleri*, though of course this is unimportant.

Occurrence.—Black River, Kirkfield, Ontario.

Holotype.—U. S. N. M.

LICHENOCRINUS SPP.

Plate XXXVII, Figs. 10-11.

Remarks.—The specimen shown in Figure 10 is completey collapsed with the plates resting directly on the host. The plates are convex and approximately uniform in size. The column and plates surrounding it are lost. The characters are therefore too indistinct to permit identification. The group of specimens shown in Figure 11 are very small. Their plates are convex and show a few incised lines paralleling the margin. The relationships of these forms are uncertain; they might possibly be related to *Lichenocrinus ornatus* but the characters due to the small size of the specimens are too indefinite to warrant certain identification.

Occurrence.—Decorah near Rochester, Minnesota.

Figured specimens.—Nos. 600 and 669, U. C. M.

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[3] This Journal, vol. 11, p. 476, 1929.

LICHENOCRINUS AFF. ASHMANNI C. L. FABER.

Plate XXXVII, Fig. 12.

Lichenocrinus ashmanni Faber, Am. Mid. Nat., vol. 11, p. 468, pl. 34, fig. 5, 1929.

Description.—One specimen closely resembles the holotype of *L. ashmanni* C. L. Faber in general appearance though it is somewhat smaller. It has a pronounced irregular ridge though not as sharp as that of *L. ashmanni.* The plates surrounding the column are large and flat and are arranged in one to two circular series. The plates forming the ridge are slightly larger than the crater plates and in forming the crest have portions sloping toward the crater and toward the margin. A few of these plates have low rounded elevations in the center. The plates from the ridge to the margin are flat or convex and have no definite arrangement.

Dimensions: maximum diameter 7.4 mm.; diameter of the crater 3-4 mm.; diameter of the base of the column 1.5 mm.

Remarks.—Though the specimen under consideration is from the Decorah and *L. ashmanni* is from the Mt. Hope the close similarity does not seem to warrant a separation, at least until more and better material is found.

Occurrence.—Decorah formation of the Black River, Fountain, Minnesota.

Figured specimen.—No. 599 U. C. M.

EXPLANATION OF PLATE XXXVII.

(NOTE: U S. N. M.—U. S. National Museum; U. C. M.—University of Cincinnati Museum. Figures x2 unless otherwise stated.)

FIGURES PAGE

1. *Lichenocrinus nodosus minnesotensis* n. var.----494
   The holotype showing the relatively large plates near the periphery. (U. S. N. M.)

2—3. *Lichenocrinus nodosus* aff. *minnesotensis* n. var.----495

2. A small specimen with plates not clearly demarked. From the same locality as the holotype. (U. S. N. M.)

3. A specimen distorted in growth. It is similar to the one shown in Fig. 2 and like it is provisionally placed in this variety. (881 U. C. M.)

4. *Lichenocrinus austini* n. sp.----495
   The holotype showing the uniform plates. (U. S. N. M.)

5—8. *Lichenocrinus* aff. *crateriformis* Hall----496

5—6. Two specimens closely related to *L. crateriformis* Hall. (U. S. N. M.)

7. Another specimen closely related to *L. crateriformis;* the wide, flat crater is typical of that species. (875 U. C. M.)

8. A specimen with a small deep crater and small column; it is here considered with forms related to *L. crateriformis.* (U. S. N. M.)

9. *Lichenocrinus ornatus* n. sp.----496
   The holotype showing the large body plates marked by incised lines and low rounded elevations. Numerous small plates can be seen near the periphery. (U. S. N. M.)

10. *Lichenocrinus* sp. ----497
    A specimen from the Decorah; it is flattened and some of the plates are lost. (600 U. C. M.) x 5.

11. *Lichenocrinus* sp. ----497
    Several specimens also from the Decorah; these are too small to show clearly their characters. (669 U. C. M.) x 5.

12. *Lichenocrinus* aff. *ashmanni* C. L. Faber----498
    A form from the Black River showing a close relationship to the Mt. Hope from of *L. ashmanni.* (599 U. C. M.)

STROPHOMENA FILITEXTA HALL, A VALID SPECIES.[1]

CARROLL LANE FENTON.

In a recent paper describing "Forms of Strophomena from Black River and Richmond Formations,"[2] I discussed the supposed equivalence of *Strophomena incurvata* (Shepard) and *S. filitexta* Hall. The conclusion reached was that *S. incurvata,* never having been described adequately from the original material, must be abandoned; and that in lieu of adequate redescription, *S. filitexta* must suffer like fate.

There is mention, also, of the lack of types: "Although the types were supposed to be in the American Museum of Natural History, Dr. Reeds writes me that they are lost."[3] This is an unfortunate over-statement of the case: Dr. Reeds' actual words were "we do not seem to have the types of *Strophomena filitexta* figured by Hall in Volume I of the *Paleontology of New York,* which you requested. Hall called this species *Leptaena filitexta* . . . . and all of the types that we have of that species refer to Volume VIII and not Volume I of the Paleontology of New York." Dr. Reeds has kindly called my attention to my error concerning the earlier types, at the same time announcing that another search has discovered them. Through his kindness the specimens have been loaned for study and description. There seems no doubt that they represent a distinct species, and as such they are here described.

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[1] Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 11.

[2] This Journal, vol. 11, pp. 144-159, 1928.

[3] This Journal, vol. 11, p. 147, 1928.

STROPHOMENA FILITEXTA HALL.

Plate XXXVIII, Figs. 1-5.

Leptaena filitexta Hall, Pal. N. Y., vol. I, p. 111, pl. 31 B, fig. 3 a-f. 1847.

Strophomena filitexta Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, p. 251, pl. 9, fig. 6. 1892.

Description.—Shell large, thin to moderately thick. Dimensions of two specimens: length 31.5 and 30 mm.; width 47.5 and 44.8 mm.; thickness 11 and 4.5 mm. One pedicle valve has a thickness of about 10 mm.

Pedicle valve flattened umbonally except at the beak which projects rather sharply. Cardinal area wide and high, deltidium prominent. Muscular area large, elevated; teeth prominent. The muscular area is divided into two lobes by a broad, low septum which originates near the beak and bears the linear adductor scars. Diductor scars striate, sharply pointed and elevated anteriorly. The intramarginal thickening is crossed by straight, narrow vascular sinuses, and the surface is finely tuberculate.

Brachial valve flat umbonally, convex medially and flattened again anteriorly. The extremities are recurved, but in none of the specimens at hand are they crenulate. The surface is marked by rounded costae which increase by implantation; over most of the shell there is pronounced alternation, every fourth to eighth costa being larger than the rest. The costae are crossed by closely spaced, concentric wrinkles, as shown in Figures 4-5.

Remarks.—Although distinct from any other form of *Strophomena, S. filitexta* is closely realted to *S. auburnensis* of the Auburn formation of Missouri and *S. plattinensis;* and anyone who gives the term species great latitude would be justified in reducing these latter to subspecies. A more satisfactory procedure, however, is to associate them in a single

gens, which may well take its name from *S. filitexta*—the *Strophomena filitexta* gens.[4]

It may be commented, also, that the types of *S. filitexta* represent two slightly differing forms, from apparently different strata. The unquestioned cotypes (Figures 1 and 2) belong to the typical black Trenton limestone; the costae are coarse and anteriorly not distinctly alternating. Those of Figures 3-5 may be plesiotypes only, since neither is figured in Volume I of the Paleontology of New York, and only one in Volume VIII. Their matrix is a brownish, oxidized limestone though where partly exfoliated the fossil itself appears to be black. Differences in costae have been mentioned; those in the character of the muscular area may be seen by comparing Figures 2 and 3.

Because of these discrepancies among the type specimens, it seems necessary that one of them be designated as the specimen on which this redetermination of *Strophomena filitexta* is based. Hall's original description indicates that this should be the complete shell illustrated by Figure 1 of Plate XXXVIII. Unfortunately, that specimen furnishes no really diagnostic characters and adoption of it as a lecto-holotype would mean that future identifications of the species could not be made. The pedicle valve shown in Figure 2, on the other hand, shows characters which are diagnostic, and which can be recognized even in Hall's original figure. For this reason, chief reliance is placed upon it, though it hardly can be selected as a lecto-holotype.

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[4] The term gens is one which deserves more frequent use than has been given it in American paleozoology. It was proposed by Vaughn (Quart. Journ. Geol. Soc., vol. 61, p. 183, 1905) to include "the aggregate of all the species which possess, in common, a large number of essential properties, and are continuously related either in space or time." As Bather remarks (Quart. Journ. Geol. Soc., vol. 83, p. lxxxviii, 1929) the gens is thus synonymous with the less convenient term "collective species" (Collectivart) of Waagen, and fits excellently such cases as *Strophomena filitexta* and its relatives. It has been employed in similar instances by Williams (U. S. Geol. Surv., Prof. Paper 79, pp. 53, 77-79, 1913.)

EXPLANATION OF PLATE XXXVIII.

FIGURE

1—5. *Strophomena filitexta* Hall.

1. Brachial view of the cotype to which the original description most clearly refers.

2. Internal view of a pedicle valve, showing diagnostic characters relied upon in this description.

3. Internal view of a second pedicle valve, not typical.

4—5. Enlargements of the surface of a brachial valve, x 10. In Figure 4, the strips of paper mark the portion illustrated by Hall and Clarke.

(All specimens, No. 702 A. M. N. H.)

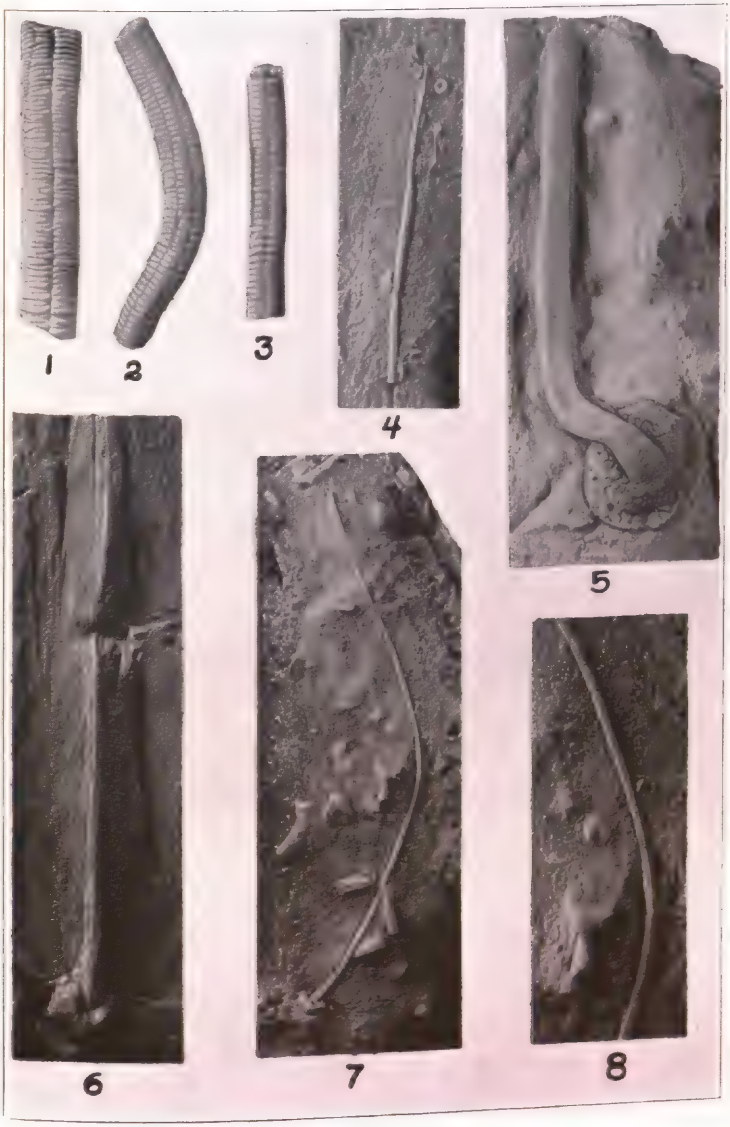

Plate XXVII

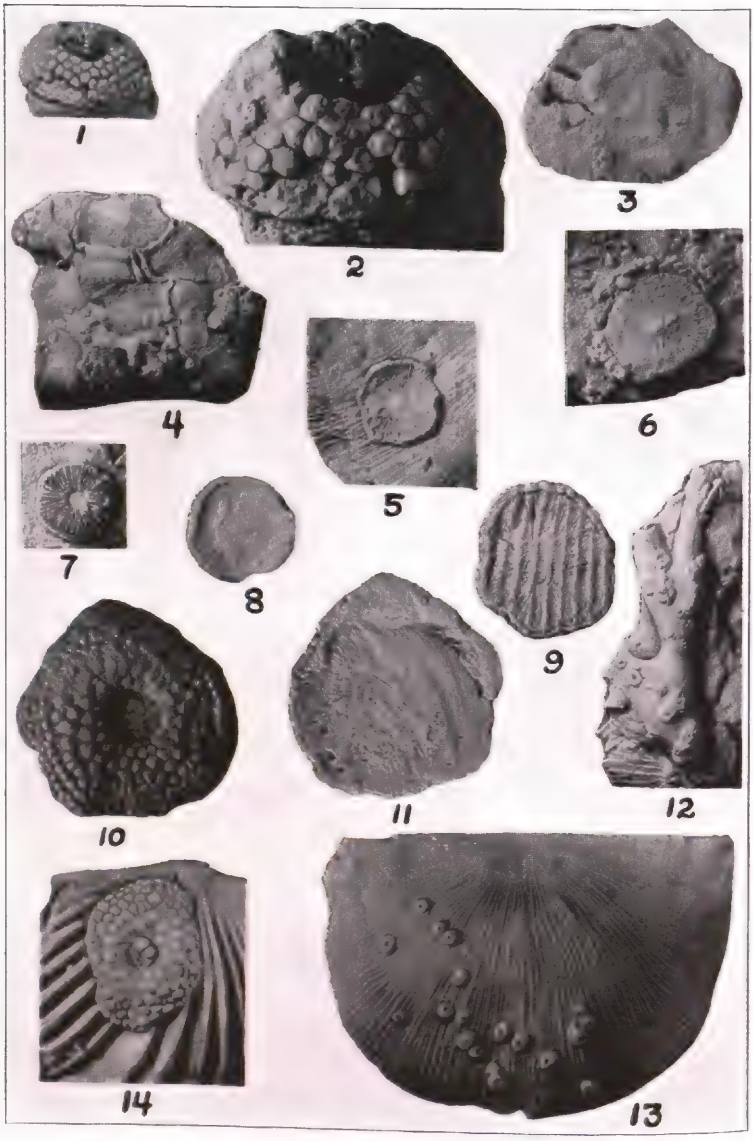

Plate XXVIII

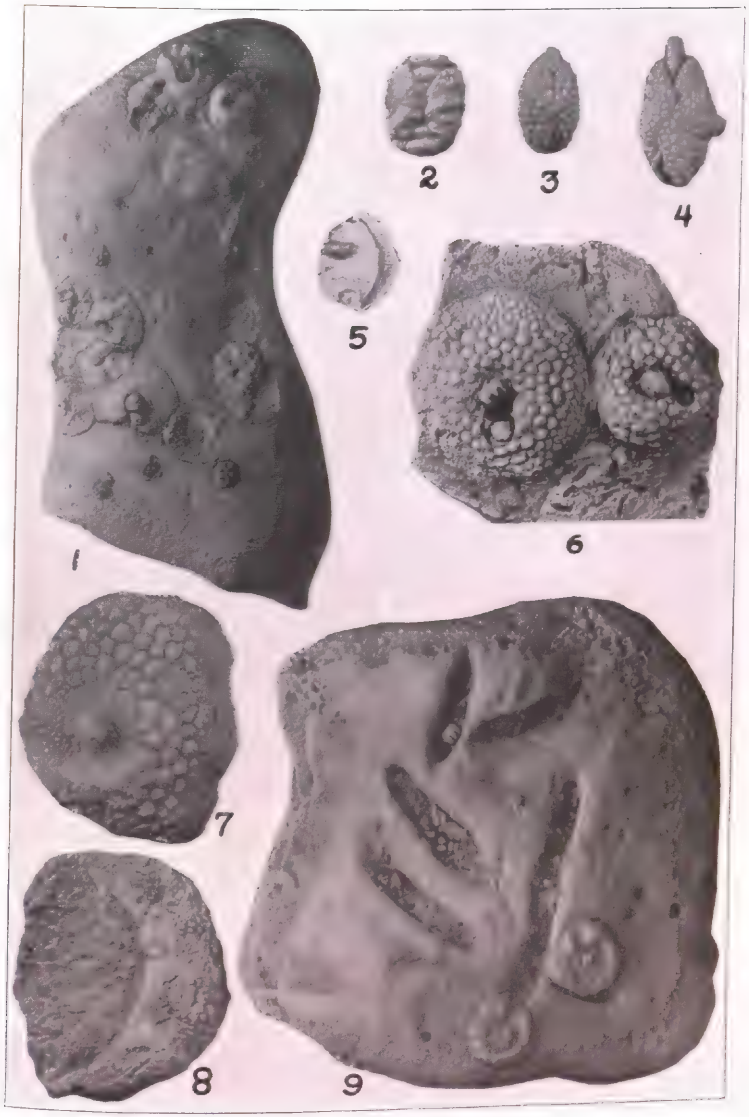

Plate XXIX

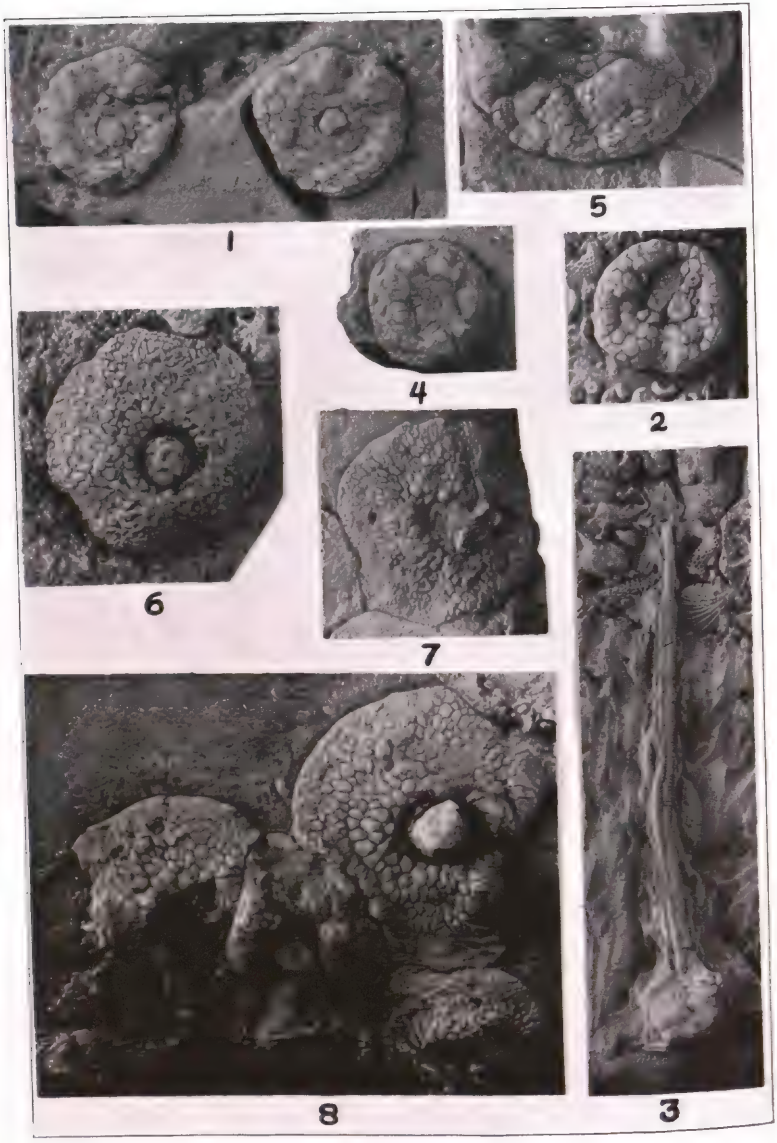

Plate XXX

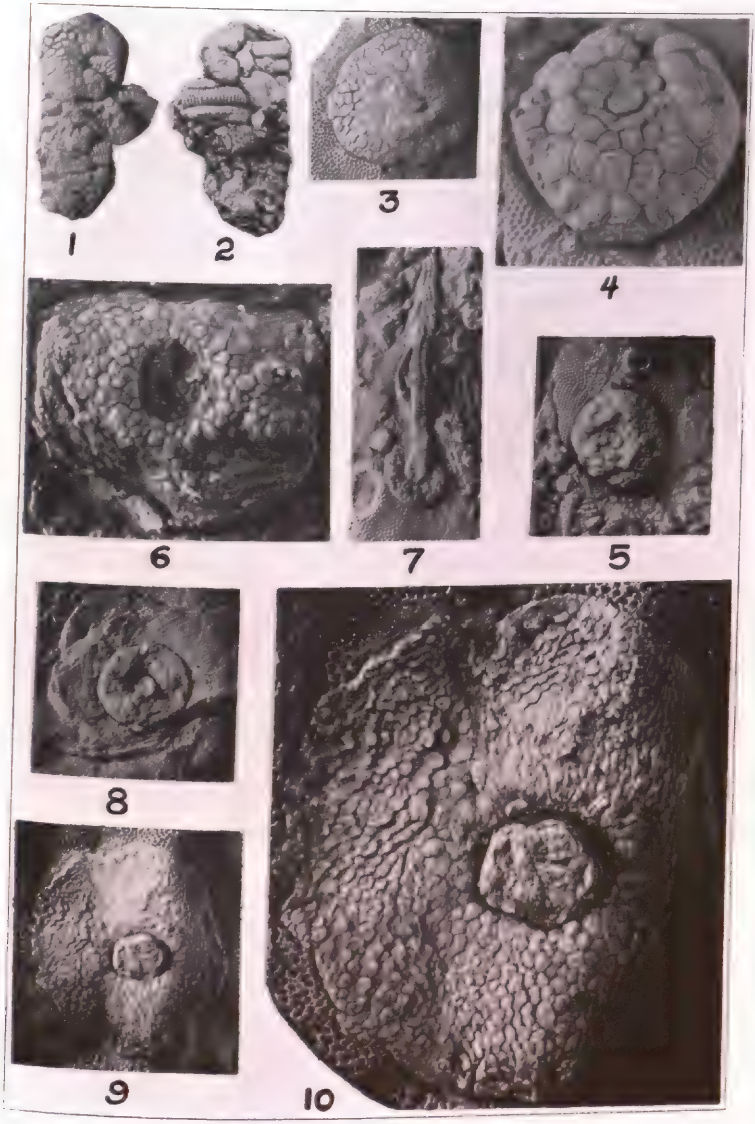

Plate XXXI

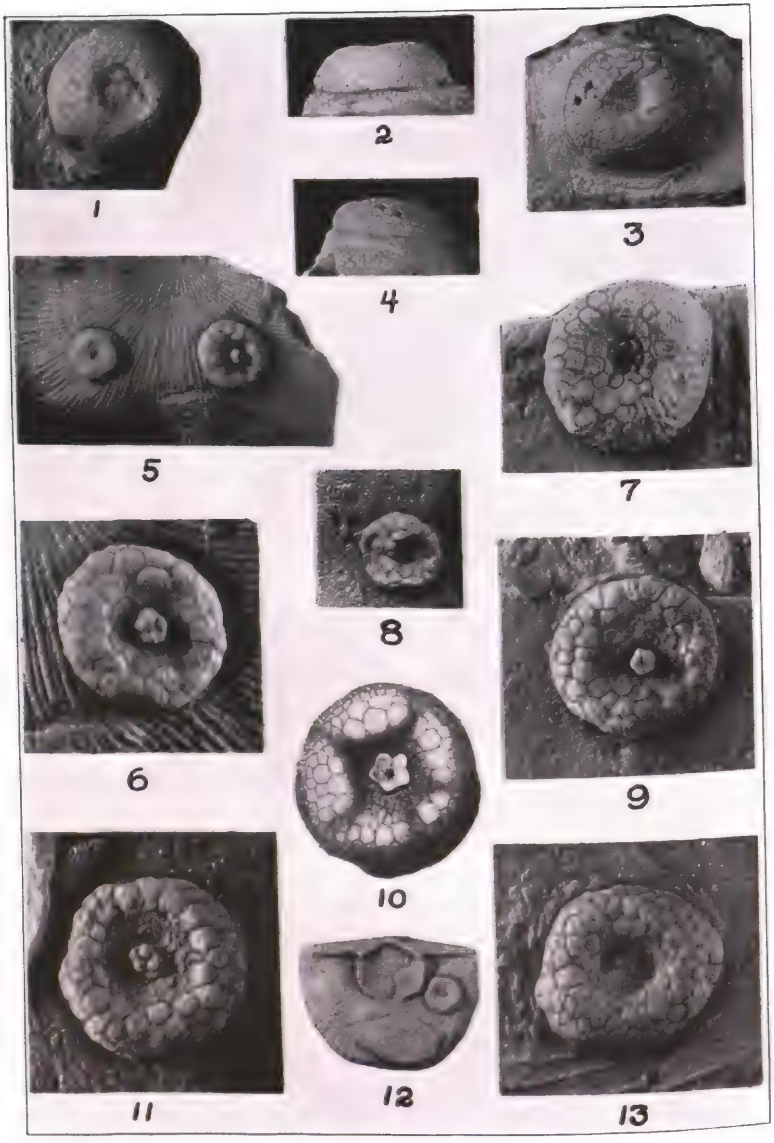

Plate XXXII

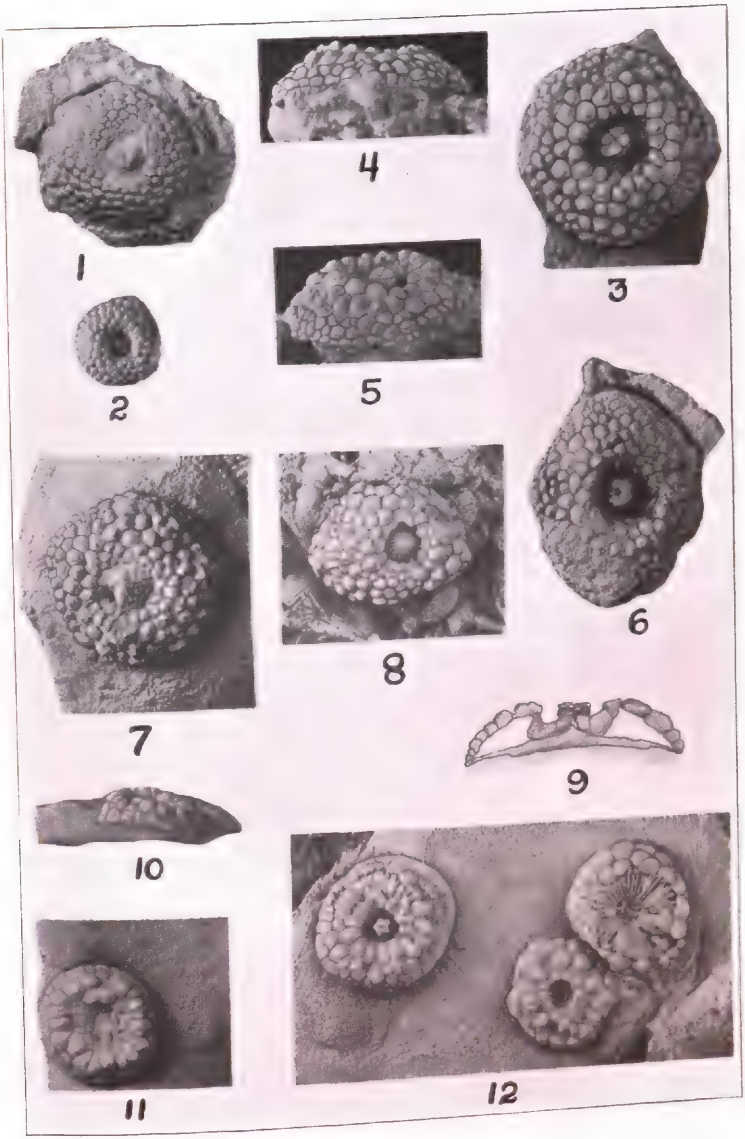

Plate XXXIII

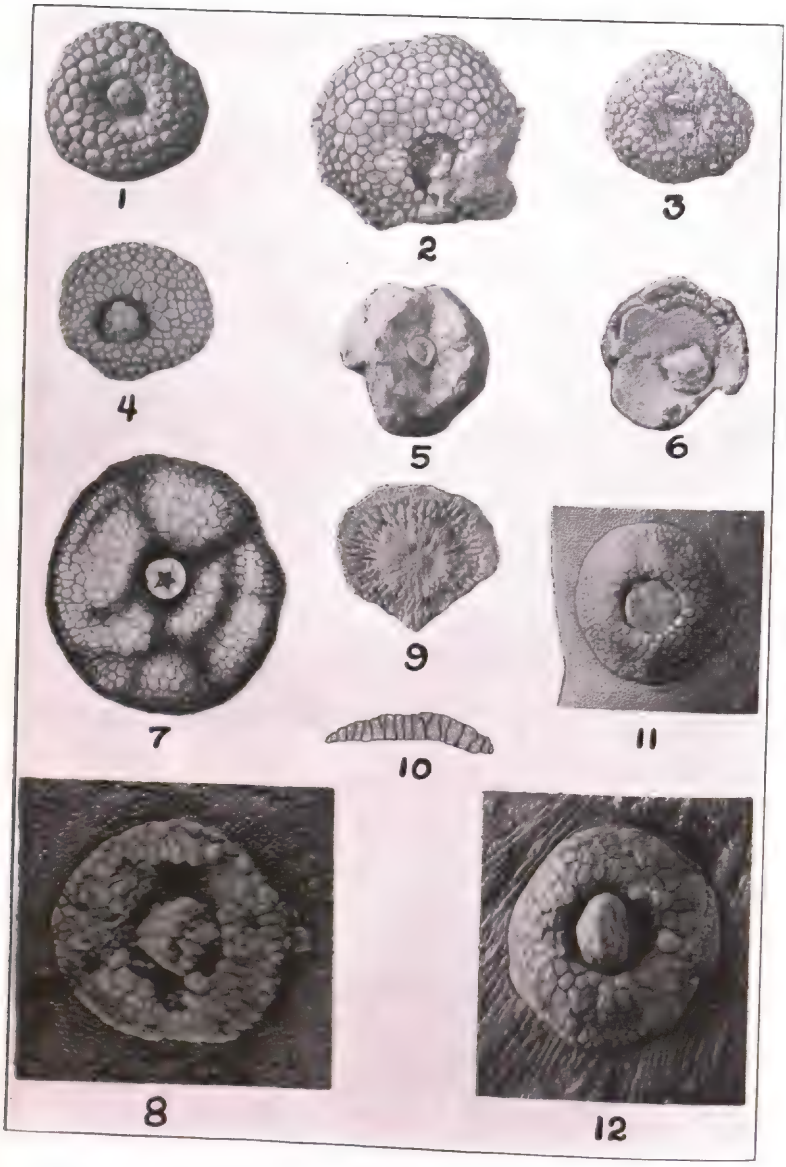

Plate XXXIV

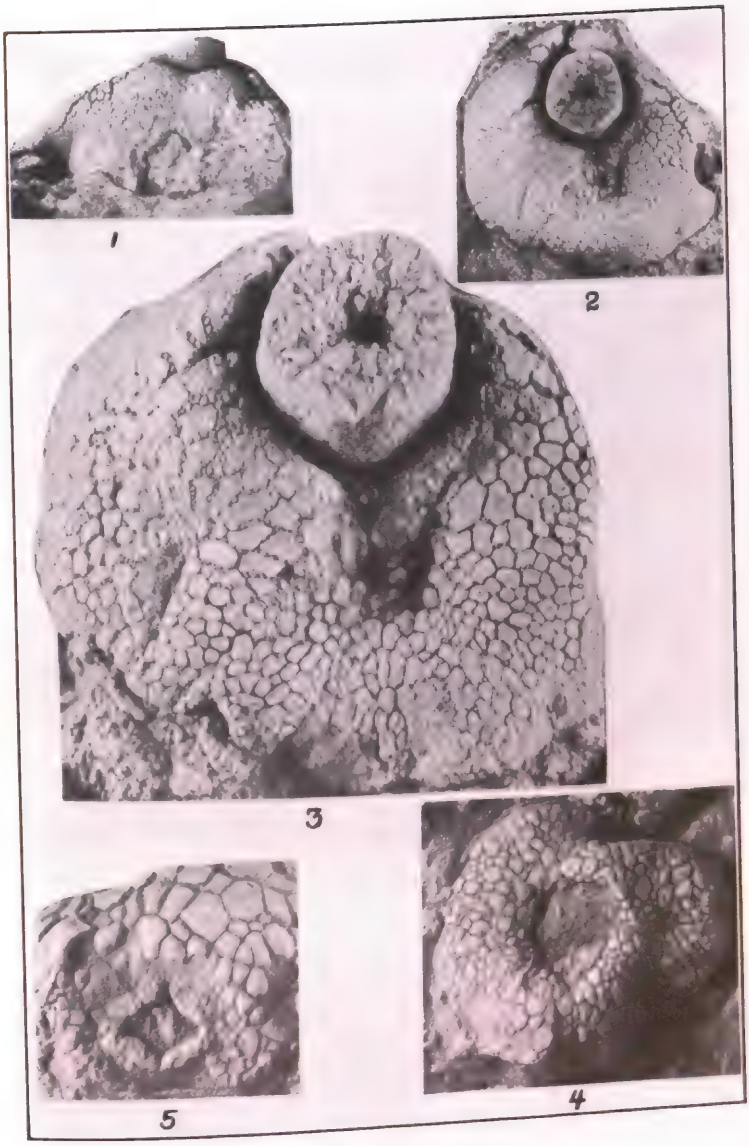

Plate XXXV

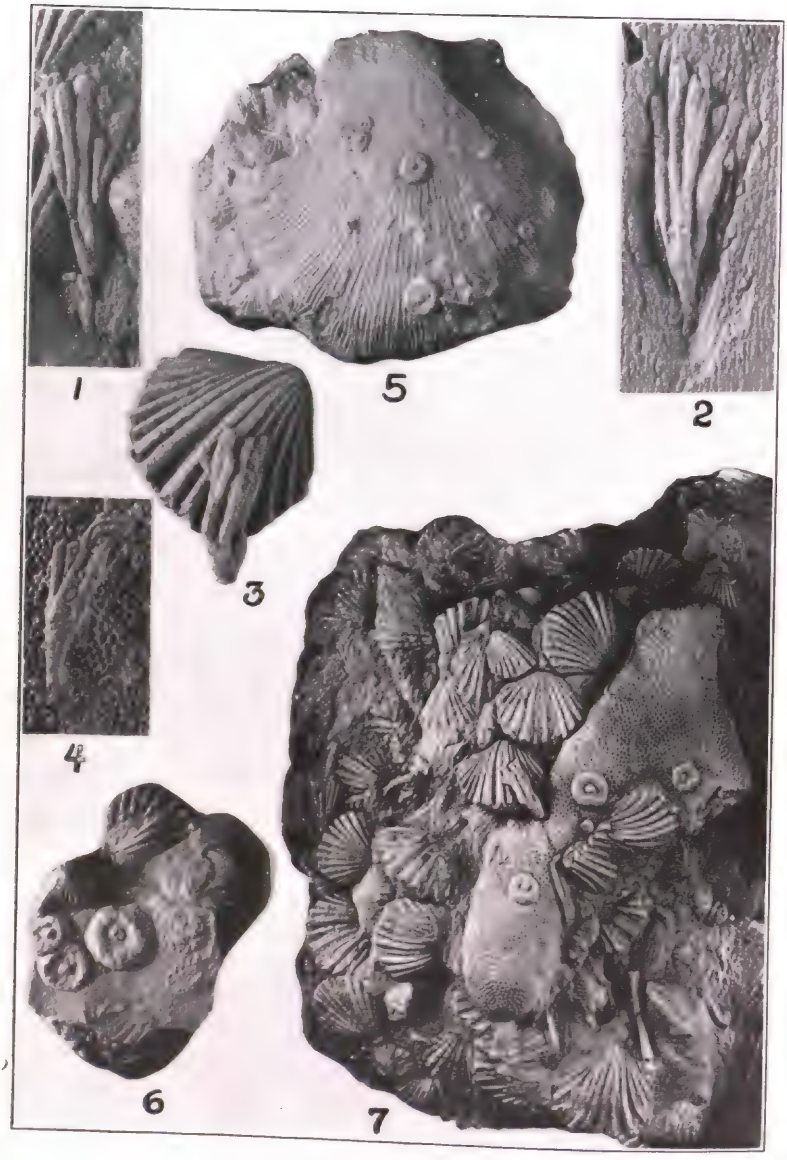

Plate XXXVI

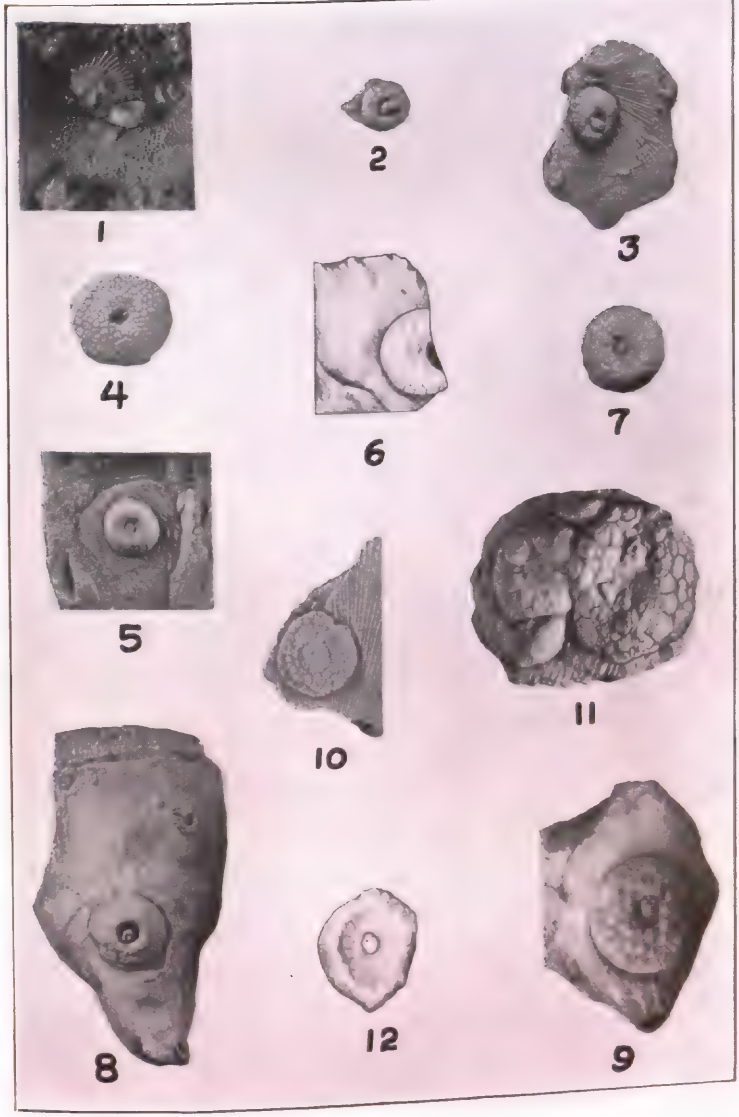

Plate XXXVII

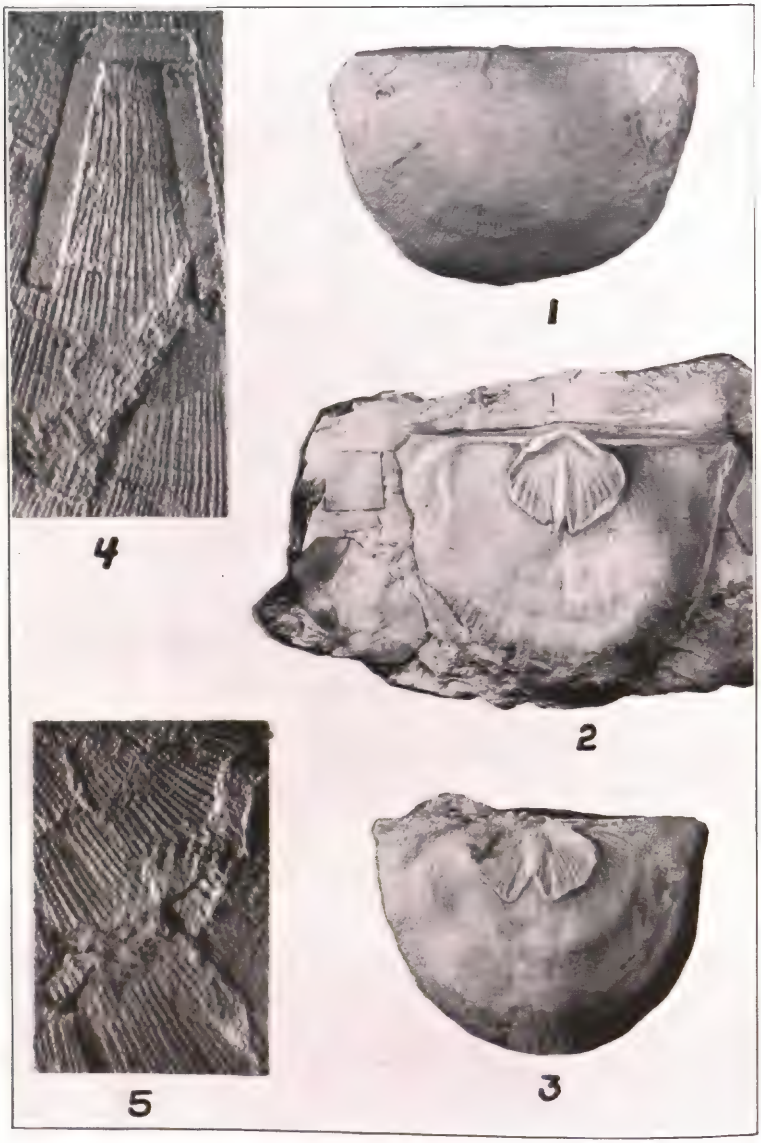

Plate XXXVIII

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Vol. XI. JULY, 1929. No. 10.

THE ANATOMY OF STENOBOTHRIUM MACROBOTHRIUM, DIESING.

FRANCIS J. WENNINGER, C.S.C.

The work reported in the following pages contains the results of an investigation carried on in the laboratory of the First Institute of Zoology of the University of Vienna, and was accepted by the faculty of that University in part fulfillment of the requirements for the degree of Doctor of Philosophy. The work was suggested in outline by Dr. Theodore Pintner, professor and head of the Institute, who placed at my disposition valuable personal material as well as the resources of the Institute and was ready at all times to interrupt his own investigations to assist me in every way. I wish here to acknowledge my indebtedness to Professor Pintner and to thank him sincerely for his help.

I am grateful also to Dr. Frederick von Querner, the able assistant of Professor Pintner, for his help in making the plates that illustrate the text.

Arabic numbers occurring in the text refer to the corresponding numbers in the bibliography.

Stenobothrium macrobothrium has been known to science since the time of Diesing, in 1863, though, up to the present,

no study of its anatomy has been made. The species appears under the following names:

Tetrarhynchus bicolor, Bartels
Bothriocephalus bicolor, Bartels
Tetrarhynchobothrium bicolor, Diesing
Stenobothrium macrobothrium, Diesing

The literature hitherto published concerning the occurrence of the species includes lists of museum material, with indications of the origin, as well as records of actual finds together with dates and names of hosts. The following is a resume of the information available on the subject.

I. Material from the Imperial and Royal Museum of Natural History in Vienna. This material is preserved in five glass containers. A short description of the material, including labeling and numbering follows.

1. "Stenobothrium appendiculatum, Rud. Salmo salar. hip. 651." This is a single poorly preserved specimen of a larva having a total length of 5 mm. Four millimeters of the entire length is scolex and collar, leaving only a single millimeter for the appendage. The width of the specimen is one millimeter. No further data are given. The place of origin is not indicated.

2. "Tetrarhynchobothrium bicolor, Diesing. Orig. Coryphaena hippuris tun. ventr. 652." Numerous well preserved yellowish-white larvae together with pieces of the wall of the stomach. There are also some encysted in the stomach tissue.

3. "Tetrarhynchus. Ceylon. 667." This consists of pieces of digestive tract (stomach ?), probably of a selachian. The pieces are highly muscular, and the inner surface is longitudinally folded or furrowed. Here there are masses of proglottids, relatively well preserved, with their large rust brown, violet to black scoleces. Intermingled with the specimens and also attached to the intestinal wall are large chains of the species Anthocephalus elongatus. (Pintner, 2; 777 and 3; 191-192.)

4. "Tetrarhynchobothrium bicolor, Bartels. Larvae Pelamys sarda inter muscl. Dschidda, 12105." Many well preserved larvae.

5. "Cestodes. (6 S. Br. 8 O. Lng.) West Africa. Tetrarhynchus

bicolor, Bartels. Pelamys sarda musc. 12106." Contains a trunk and fragments of fishes with encysted and free, well preserved larvae.

II. Material from the Royal Museum in Berlin. This material is contained in ten glass bottles. The following is a list of the contents with data appended to each container.

6. "Tetrarhynchus from Carcharias 12 S. Br. 42 O. L. gr. East Africa Collector, Dr. Fischer. 1104." Several large chains and portions of chains with scoleces.

7. "Tetrarhynchus macrobothrius, Rud. T. papillosus. (Types.) Coryphaena hippuris, Tun. ventriculi. Brazil. Collector, Natterer. Collection Rudolphi, 1704." Five pieces of brown larvae.

8. "Tetrarhynchus macrobothrium, Rud. (Type) Testudio midas. Tun. ventric. Berlin. Coll. Rud. 1705." One brown larva which has the appearance of having once been allowed to dry up.

9. "Tetrarhynchus macrobothrius, Rud. Coryphaena hippuris, Tun. ventric. Coll. Rudolphi. Collector, Natterer, 1706." Two larvae apparently fastened to the wall of the stomach by the proboscis.

10. "Tetrarhynchus macrobothrius, Rud. Coryphaena hippuris ? Brazil. Coll. Rud. Collector, V. Olfers. 1707." Five typical larvae of 4-7 mm. in length. The longest is 2 mm. broad, resembling a cylinder rounded off at both ends.

11. "Tetrarhynchus macrobothrius, Rud. 1712." Several larvae turned brown. One of these shows behind the anterior end two deep furrows, resembling pronounced contraction waves. Two specimens are fastened together at the broad sides, and face in opposite directions. One specimen has penetrated with its proboscis, and with a portion of its anterior end, into another specimen. Some such phenomenon may account for the pincher-like appearance of another specimen. It might be stated here that this mutual attachment of specimens by means of a sucking apparatus is not to be interpretated to mean that the specimens have necessarily occupied the same hollow space in the host. Specimens that have been artificially released from the intestinal wall or from their cyst, and have been placed into a watch glass, begin to move as though they were seeking some object for attachment. If such an object is not found, there will be mutual attachment, and this will take place so vehemently that the animals cannot be separated without injury to one or both animals concerned. This has been observed in *Tetrarhynchus lingualis* in sea water, in *Calliobothrium coronatum* in the intestinal tract, and in *Gorgodera cygnoides* in physiological salt solution. In this last vial there is also a peculiar monstrosity. A scolex of about 4 mm. in length, instead of being followed by a single strobila, has two strobilae,

each of which has its own bladder. This recalls a case of scolex polymorphus observed some years ago by Pintner, in which there were two bladders lying side by side. The peculiarity of the case consists in this that the two strobilae, one of which already shows striations, overlie each other in the dorso-ventral position. The contact is not entirely continuous, but the contraction of the individual is sufficient explanation for this. Definite information concerning the position of those animals as well as of the development of the tail where rings are invisible could be obtained only by sectioning. This involves the destruction of the material. The report of Pintner seems to be the only one on record.

12. The label reads "T. bicolor" and this is correct. But the catalogue has "T. lingualis, Cuv. Wagner diagn. 1714." This is incorrect and can probably be explained on the assumption that the material was transferred from one container to another. The material consists of proglottides which are poorly preserved.

13. "Tetra. origin (?) 1720." This contains several macrobothrius larvae, and one small attenuatus. Some of the macrobothrii are encysted. Some of the larvae, within the cyst, are surrounded by a very fine secondary membrane.

14. "F. 488. Tetrarhynchus macrobothrius, Rud. Scolex, Ballistes, etc." This is a collection of entirely macerated and worthless fragments that have no relation whatever to our specimen.

15. "F. 489. T. macrobothrius, Rud." One larva.

16. "In Squalus, large intestine. Auckland." Many large and beautiful chains with scoleces. Among the material were chains 27 to 38 mm. in length, 8 to 9 mm. of this total length is scolex. The bothridial portion measures 6 to 6.5 mm., the postbothridial 2.5 mm., and the width is 2 to 3 mm. The specimens very probably were collected by the Novara Expedition.

The following is a resume of data available on hosts and places of origin:

(a) LARVAE. The cases 7 and 9 might be identical, though two different places of origin might be supposed. It is not unlikely that case 2 is identical with cases 7 and 9. Case 10 is an independent find. We have, therefore, the larvae of at least two and perhaps even of three or four finds from the peritoneal cysts of *Coryphaena hippuris*, all of them probably from the coast of Brazil. Two finds come from the musculature of *Pelamys sarda*, one from the Red Sea and one from the Atlantic, somewhat east of Ascension. The cases that are peculiar are

case 1. from the liver of *Salmo salar*, with no place of origin given, and case 8. *Testudo midas*, found in Berlin, by Rudolphi.

(b) CHAINS. Case 6 gives an indication as to the manner of procedure for determination, for here *Carcharias* is mentioned as the host. Likewise case 16 is significant,—"Squalus, large intestine." It is, therefore, the larger sharks that are to be considered as the final hosts. In case 6, the specimen was found between the north peak of Madagascar and Africa. The second place of origin mentioned, though without a mention of the host, is the Indian Ocean. Case 16 mentions the vicinity of New Zealand. The conclusion seems to be warranted, therefore, that the final host of our species is to be found among the larger sharks and among the wanderers rather than among the coast forms. The intermediate hosts are *Coryphaena hippuris* and *Pelamys sarda*. In the latter, the parasite was found in the peritoneal cysts or in the musculature. Infested specimens seem to abound in the tropical and subtropical seas.

For the sake of completeness, the places of occurrence in the United States are here appended. This information was compiled from records of various authors as published in the reports of the National Museum and the Fish Commission.

The larvae of the species have been reported as follows:

From *Coryphaena hippuris*, the Dolphin, (No. 5483, U. S. N. M.). Collected from the Gulf Stream on August 13, 1885. Numerous on peritoneum and mesentery. The alcoholic specimens vary in length from 4 to 8 mm., and in shape from ovate to oblong linear, according to the state of contraction. The larger specimens have distinct bothridia.

From *Xiphias gladius*, the Swordfish. (No. 4820, U. S. N. M.) Collected off Martha's Vineyard, Mass., on July 25, 1887. Lodged in the peritoneum. Three larvae of this lot were found with their proboscides penetrating the tissues of *Rhynchobothrium attenuatus*, with which they were associated. Length of the living specimen 10.5 mm. Dimensions of one alcoholic specimen length, 6 mm.; diameter, 1.25 mm.; length of proboscis, 0.56 mm.; length of proboscis sheath, 1 mm.; diameter of proboscis at base, exclusive of hooks, 0.08 mm., at apex, 0.07 mm.

From the same host, on July 15, 1904, many on viscera, in

each of four swordfish, mostly yellowish-white, some ivory white; active; 6 to 12 mm. Also on July 13, 1911, ten globular cysts on viscera. Finally on July 20, 1912, one from viscera.

From *Carcharius obscurus,* the Dusky Shark. (No. 4817, U. S. N. M.) Collected at Woods Holl, Mass., on August 12, 1887. The specimen was found adhering to the mucous membrane of the pylorus. The stomach wall was locally inflamed where this parasite was attached. There was also another ulcerated spot in mucous membrane nearby. The specimen was quite active when removed. Dimensions: length, 7 mm.; diameter of the anterior portion, 2 mm.; diameter of the middle portion, 2.5 mm.; diameter of the posterior portion, 1.5 mm.; diameter of the posterior appendage at the beginning of the strobila, 5 mm.

From *Galeocerdo tigrinus,* the Tiger Shark. (No. 4825, U. S. N. M.) Collected at Woods Holl, Mass., on August 14, 1889. Specimens from the stomach. Dimensions: length, 5 mm.; maximum diameter, 1.4 mm.; length of the proboscis, 1 mm.; diameter at base, 10 mm.; diameter near middle including hooks, 08 mm.; length of hooks, 026 mm.

Four specimens from the peritoneum and mesentery of *Xiphias gladius,* the Swordfish. (No. 4829, U. S. N. M.) Label reads, "September 21. Trawlline, U. S. Fish Commission."

From *Echeneis naucrates,* the Sucker. On August 31, 1920. Five white globular cysts, 3 mm. in diameter, from the serous coat of the stomach and intestines.

From *Lophius piscatorius,* the Goosefish, on July 29, 1910. One specimen, 7 mm. long.

From *Sarda sarda,* the Bonito. Two specimens under the peritoneum. June 27, 1910.

The following data have been compiled on the adult parasites of our species. Where no other locality is indicated, Woods Holl, Mass., is to be understood.

From *Charcharinus obscurus,* the Dusky Shark.

1905, August 14. Two; head and neck, including collar of one, deep

purplish red; strobilas 30 and 45 mm. respectively. A fragment of the strobila measured 110 mm. in length; largest proglottides, length 1.2 mm., width 3 mm., length of ehad and neck 6.5 and 9 mm.

1907, July 31. Two in shark, measuring 183 cm; one of the worms was firmly attached to the mucous membrane. Length of the longer in sea water was 200 mm.; length of the scolex at rest 11 mm; stretching to 20 mm.; diameter, 1.75 mm. The face of the strobila on which ova lie is convex, the opposite side is concave. Ova variable, but the larger ones measuring .031 by .024 mm. Shells of the ova are very thin.

From *Galeocerdo arcticus*, the Arctic Shark.

1905, August 26. Three scoleces adhering to the mucous membrane of the stomach.

1913, August 13. One attached to the mucous membrane of the stomach. Length of the scolex, 5 mm.; of the strobila, 6 mm.; segments beginning short and much narrower than the scolex.

1914, August 12. Six scoleces from the mucous membrane of the stomach. At one point where some of the parasites were attached there was considerable suppuration. All were short, but one showed the beginnings of a strobila. This one measured 18 mm. in length; no segments.

1915, August 6. Associated with *T. bisulcatus;* a number of them being attached together near the anterior end of the stomach in a pit of the mucous membrane which was abraded and inflamed. (U. S. N. M., Helm. Coll. 1721.)

From *Coryphaena hippuris*, the Dolphin.

1899, August 23. One encysted in the peritoneum.

1902, August 1. Two from cyst in stomach wall.

From *Galeocerdo tigrinus*, the Tiger Shark.

1899, August 19. Several attached to and penetrating the stomach wall.

From *Carcharinus Milberti*, the Blue Shark.

1922, July 10. One specimen attached to the wall of the spiral valve.

From *Paralichthys dentatus*, the Flounder.

1899, August 15. One in material washed from the alimentary canal.

The data presented seems to warrant the conclusion that *Stenobothrium macrobothrium* is a cosmopolite, and that its hosts are exclusively members of the shark family. There

seems to be only one record of the occurrence of the parasite in a host that does not belong to this family. This suggests that perhaps due to an interchange of materials or to some other cause, there is here at least the possibility of an error.

Adults and larvae of old museum material can be recognized and differentiated by their coloration. Adults invariably have the anterior portion, that is, the head and a considerable portion of the scolex, colored a deep black. The color may be equally and uniformly distributed, or it may appear in spots and stripes. The coloration of the head frequently ceases abruptly at the juncture of the head and neck and is confined to that portion of the head which is anterior to the neck proper. Occasionally there are isolated patches of color, or even entire stripes on the strobila. The quality and intensity of the coloration seem to depend both on the medium in which the specimens are preserved as also on the light. The color varies from a violet to a dark brown to black. The first impression one gets is that the entire phenomenon is one of incrustation. Indeed, the microscope shows very fine needles and spicule-shaped crystals which appear opaque and entirely black and do not resolve in the light. These crystals seldom appear singly but nearly always as star-shaped, cross-shaped or even globular. In all these various arrangements, the needles always converge at a given point. They lie at a depth of only a few micra from the cuticle, though a few crystals may penetrate the cuticle or may even lie on the body surface. It may be stated, however, that this latter condition is found only in old material in which the integument is either badly injured, or from which it has almost entirely disappeared. It may also happen that individual bundles of crystals are pulled to the periphery by the knife of the microtome. Single strands or wire-like structures appear in the interior of the body, especially near or actually in the tissues of the great lateral trunks of the nervous system. Here they suggest an unsuccessful Golgi stain.

The black structures do not seem to belong to any particular tissue, or to particular cells, nor to the skeletal sub-

stance, but seem to be a substance that partakes of the nature of a colloid sediment formed by combination of a foreign fluid with the fluids of the body.

Larvae that are still enclosed in cysts, or such as have only recently been removed from cysts, are colorless. But even in these forms, pigmented needles are sometimes found. These are isolated and not arranged into bundles, are still transparent, and lie on the outer stratum of the body, apparently on the surface.

All these appearances give the impression of a precipitate artificially formed. However, they occur in all specimens, and in all collections without exception. This constant recurring of the phenomenon induced Bartels, Diesing and Dujardin to recognize the specific name *bicolor*. The occurrence of pigmentation in larval forms seems to indicate that neither the nature of the intestinal tract nor the character of its contents is of any consequence in the formation of the pigment.

A microchemical analysis made by Molisch of Vienna was published by Pintner in 1914. But the examination of the Valdivia material shows that the composition of the pigment is not the same as that previously reported from other museum material. There is a notable lack of intensity,—to mention only one of the macroscopic differences. The impression one gets at first sight is that created by the pigmentation ordinarily met with in all Cestode material. In sections, this pigment appears not as crystals but as minute, black, opaque globules that are seldom isolated but appear as irregular masses. The distribution of the pigment itself is essentially irregular and is to be found principally between the longitudinal muscles and the outer zone of the excretory system. The denser distribution is always towards the periphery. This seems to indicate that the velvet sheen of the coloration of old specimens comes from small crystalloid structures. There seems to be no other explanation possible than this, that during almost a century during which the specimens have lain in preservative fluid, the granular pigment became crystalized. In view of the fact that most of the specimens of the Valdivia

Expedition were either in formaldehyde or corrosive sublimate or in alcohol, as was the case with the oldest specimens, as well as because of the fact that all the specimens were rinsed in water before fixing, this explanation seems the most plausible.

Before entering upon the subject matter itself of this treatise, an explanation of the terminology followed will be useful. The terms used here were first enployed by Pintner. (36) There can hardly be any question of their entire appropriateness and general usefulness. They are appended here in the hope that a more general knowledge will lead to a more general appreciation and eventually adoption.

Pars bothridialis scolecis (pbo) designates that anterior portion of the head which carries the four bothridia.

Pars vaginalis (pv) is that portion of the head-stalk or peduncle (Kopfstiel) which bears the proboscis sheath.

Pars bulbosa scolecis (p. bulb.) is that portion of the head in which the muscle clubs of the proboscis are situated.

Pars post bulbosa scolecis (p.pb.) is the term used to designate all the remaining portion of the head.

A chain of segments is called *apolytic* or *anapolytic* according as the individual proglottids either break off automatically or not. An *apolytic* chain may be *eupolytic* or *hyperpolytic* according as the various segments continue to develop or not after breaking off from the chain.

The terms *craspedote* and *acraspedote* are used to designate the manner in which the various segments of a chain fit into each other. The presence of a velum in the preceding segment which fits into a succeeding one is indicated by the term *craspedote;* the absence of this velum is expressed by the term *acraspedote.* In the former case there will be left a toothed margin; in the latter case, the margin will be straight-lined.

The genus *Stenobothrium* of which *macrobothrium* is a species has the following characteristics. There are four bothridia. Of these, two belong to a dorsal and two to a ven-

tral group. Their margins are fitted up with minute hairs. The scolex is craspedote. The proboscides are poorly developed. The individual proboscis is thin, short, thread-like, with similar small hooks which are relatively widely spaced. The sheaths are short and thin, and the clubs are small. These latter are composed of numerous small and very thin muscles contained in six cups, each of which is, in turn, composed of several layers of muscles. The musculature of the clubs on cross section is, to use Pintner's phrase, arranged after the manner of four horses running apace in the ring, with the thinnest portion of the head representing the rear of the horse.

The strobila is anapolytic, with all the segments, even the last, wider than long. Margins are entirely smooth-rimmed, and flanked on both sides by straight lines.

The genital cloaca is located at the anterior margin of the segment, but in a ventral position, with its end turned backward. The uterine openings are median and run in a straight line. The uterus is many-branched and ventral in position, while the testes are dorsal. The ovaries consist of structures resembling in arrangement the wings of a butterfly. There are five or six discernible layers. The connecting tubules are frequently so thin that only a single egg can pass through at a time. (Fig. 9.)

At the end of each segment there is a muscular septum. (Fig. 4.) The primary end segment bears a conical plug which is protrusible from the bladder and may be villous, as in *macrobothrium*, or papillated, as in *linguale*. A final character, and one first reported by Pintner in 1928, is the presence of a bladder in each segment. (38)

Macrobothrium illustrates all the characters just mentioned as generic. The special and specific characteristics will be indicated as they are met. The species occurs in considerable numbers in the sharks. The material examined for purposes of this report all came from one species of host,—*Carcharias lamia*, but the literature on the subject mentions specifically fourteen other hosts for this Cestode. There is

considerable variation in the size of individual specimens, the total length ranging from 32 to 230 mm. The last measurement is given by Linton. (21) The longest of my specimens measured only 82 mm. and had 140 segments.

The head of *macrobothrium* has been described in outline by Pintner. (33) For purposes of completeness, a short resume of his report is here appended. The head is subconical and bluntly rounded in front. It averages 12 mm. in length, is thin and craspedote. There are four bothridia, two being dorsal and two ventral. The pars bothridialis measures about 12 mm. This represents the most excessive elongation known among the Tetrarhynchoids. Indeed, in this species, the head attains a length which is several times greater than that of all the remaining portions. The pars vaginalis is contained in the pars bothridialis. The pars bulbosa measures .06 mm., and the pars post bulbosa measures 4 mm. The proboscides are poorly developed. They are thin, short, thread-like, about a millimeter long, with uniform, widely separated hooks arranged in spirals, each spiral bearing about seven solid hooks. The bothridia are rudimentary.

The chain of segments is anapolytic, usually much attenuated anteriorly and unjointed for a short distance back of the head. Fine transverse lines soon appear, and, shortly after, the first segments are formed. The latter are usually much broader than long and are invariably rectangular in outline. There is a marked dorso-ventral differentiation. Individual segments are from 2.5 to 3 mm. broad, while one of the last segments measured .025 mm. in length.

The cirrus always opens laterally and marginally, irregularly alternate. (Fig. 2, 6.) One specimen that measured 44 mm. in length showed 54 openings of the cirrus between the 65th and the 119th segments. Of these, 30 openings were on one side and 24 on the other. More than four consecutive openings were never found on one side. The cirri are entirely withdrawn into the sheath, or they protrude more or less. The cirrus sac runs along the anterior margin of the segment, with its apex bent backwards. The cirrus and its sac are in-

variably half as long as the width of the including segment.

The vagina is dorsal to the cirrus and a little to the rear where it frequently breaks through the mass of the vas deferens. (Fig. 6.) The genital cloaca lies towards the anterior margin and somewhat ventral. The uterus is branched and lies on the ventral side. The uterine openings, which are never preformed, lie in a median line, strictly one after the other. At the end of each segment there is a double-layered muscular septum. The primary end segment bears a villous or papillated plug which is extrusible from the interior of the bladder. As a special external characteristic of the species, a rather conspicuous muscular band must be mentioned. (Fig. 5.) This runs medially throughout the entire length of the individual specimens on both dorsal and ventral surfaces.

The species is clearly protandrous, i. e., the male elements reach maturity before the female elements. The primary end segments were missing in nearly all the specimens examined. A typical specimen having this end segment was found to have a total of 120 segments, and the uteri of the last 60 segments contained eggs. But portions of strobila were found in which individual segments contained no eggs at all. The explanation for this phenomenon was given so long ago as seventy years by E. Van Beneden and is quite generally understood. Many of the segments on stimulation by chemical or mechanical means, or even on mere contact with water, burst and send out streams of eggs.

The body of *macrobothrium* is composed of the tissues and organs that are generally found in all Cestoda. This paper will confine the discussion to those elements only of the integument, the muscular and excretory systems, and the organs of reproduction which seem to be peculiar to the species.

The cuticle is rather thick. Inspection with the oil immersion lens shows the presence of minute hairs covering the entire surface. Under this villous covering, the cuticle is distinguishable as a two-layered sheath. The outer layer is homogeneous in nature while the inner layer is very finely granulated. It must be emphasized, however, that the two

layers form an organic unit with no line of demarcation between them. The transition from the cuticle to the subcuticular layer is here quite apparent. The inner line of the cuticle goes over into very regular and closely fitting arcade-like structures, the fibers of which penetrate into the bodies of the subcuticular cells. To show this structure to greatest advantage, Pintner suggests a method of double staining with iron haematoxylin and orange g. The arcade prolongations are more numerous than the subcuticular cells with the result that many of them end in each cell.

The muscular system of *macrobothrium* is characteristic. Mention has already been made of the thick band of muscle that runs medially throughout the entire length of the individual on both dorsal and ventral surfaces. This is a specific character. The longitudinal muscles on either side of the median muscle number about twenty. They are about half as wide as the median band. The transverse muscles lie on the surface, above the longitudinal muscles, and seem to have about the same width throughout. On cross section, the median band is seen as a mass of muscle fibers not unlike the cut end of a cable. The mass is compact so that individual organs as, for instance, the bladder, to be mentioned more in detail later on, are diverted from their regular path or position and bent sideways. It is the median muscle, moreover, that forms the longitudinal furrow visible along the whole length of the strobila. This furrow is, perhaps, the most conspicuous single characteristic of the species when viewed macroscopically only. The peripheral longitudinal muscles are really in two layers. One, a stout layer, occurs at regular intervals and seems to give contour to the specimen. The other, a considerably weaker layer, is wedged in between the stouter layers and occurs somewhat irregularly. It is only about half the size of the stout layer. On cross section, the general appearance of these peripheral muscles might be said to be palisaded.

The excretory system in *macrobothrium* is built along the lines laid down for Cestoda in Bronn's *Klassen und Ordnun-*

gen des Tierreichs, Vol. Vermes, p. 1361 et seq. There are four main trunks and these are large enough to be seen with ordinary powers of the microscope. Since the scope of this treatise is merely that of recording deviations from type, it will suffice here to indicate in what respects deviations occur in the species examined and briefly to explain the nature of these.

The elements of structure in which *macrobothrium* differs from the type are mainly two;—first, a branching from the main trunk, which gives rise to numerous islands, and, secondly, the presence of a bladder in each segment. Both of these anatomical features are illustrated in Fig. 5. This branching is not to be understood as a mere splitting of the main trunk into smaller tubes and a further division of these into still smaller tubes till relatively minute capillaries are reached. It is rather an anastomosing of the smaller branches to meet again in a continuation of the same, the space between forming the island mentioned above.

The presence of the bladder was first noticed by Pintner. (5; 318-322.) Its occurrence in this and allied species was first announced by him in a preliminary statement published in the *Zool. Anzeiger,* Vol. LXXVI, Nos. 11-12, I. 5. 1929. He also demonstrates that this bladder must be recognized as constituting a generic characteristic.

There are on the dorsal surface of each segment several discharging vessels of the excretory system that lead through a very narrow dorso-ventrally situated passage into a bladder. In this species the bladder is evidently connected with the complicated network of canals of the system. When it reaches the large median muscle, instead of going around it, the muscle itself is bent to one side to allow for the passage of the bladder. This excretory pore may be seen also in whole mounts. Here it appears as a diagonal split. Up to the present, this aperture has not been understood. None of the various explanations have been little more than conjectures. Such is, for instance the statement that the aperture, seemingly situated at the line of union of two segments, is a

transverse anastomosis of the organs of excretion forming a vessel running in a dorso-ventral position and ending in a sort of secondary foramen. In serial sections this structure can be followed as a dorso-ventral tube. There might be some slight difficulty in locating its position with certitude as well as in differentiating it from the openings of the uterus. However, the uterine openings of *macrobothrium* are rather high up in about the middle of the segment, while the excretory pore is very definitely situated in the posterior margin. The two points that need to be emphasized in this connection are, first, the occurrence of this excretory pore in linear position on an apolytic chain of segments, and, secondly, its occurrence in the dorsal position.

The reproductive organs of all animals, their location and structure are of prime importance. This is so because the nature and structure of these organs determine to a large extent the systematic position of the animal in question. Nearly all Cestoda are monoecious. It is also characteristic of the group that each recurring segment bears the same units of the reproductive apparatus in about the same relative position. As a rule, the Cestoda are protandrous, i. e., the male elements reach maturity before the female elements develop. One will, therefore, look in vain for testes in the posterior regions or segments, or for uteri in the anterior ones. A certain general development of the individual segments must be reached before there is any development of reproductive organs. The precise number of the segments of the strobila of *macrobothrium* in which ripe reproductive organs may be expected seems to depend, in part at least, on the total length of the specimen. I found that almost invariably the anterior third or fourth of the specimen would have no ripe proglottids, while the appearance of testes hardly ever occurred anterior to the fiftieth recognizable segment.

There are two genital openings, one for the male and one for the female organs. In *macrobothrium* these openings lie rather close together in a genital cloaca which is somewhat raised from the marginal body surface and might be called a

genital papilla. A third opening is found in *macrobothrium*, —that of the uterus.

There is no preformed uterine opening in this species, but the uterus bursts in the same place in all segments and pours out its contents. This is a factor of prime systematic importance. The laceration for the aperture always occurs in the ventral median surface of the segment. (Fig. 10.)

The male reproductive organs consist of testes, vasa efferentia, vas deferens, cirrus sac and cirrus. The literature on the genus *Stenobothrium* also mentions glands which are referred to as prostate glands. Of these I could see nothing.

The testes are innumerable. Their general position might be characterized as dorsal, though it will be, perhaps, more correct to say that they occupy the field bounded by the excretory canals in so far as this field is not occupied by other organs such as uterus and ovaries. The testes lead into the vasa efferentia, and these into the vas deferens, which is a single tube. As it approaches the cirrus sac, it becomes more convoluted, and just before it leads into the sac, these convolutions become so great as to constitute a veritable knot. The histological structure of the vas deferens seems to be very simple,—just a membrane composed of homogeneous tissue.

The cirrus sac is a muscular bag whose form, generally elongated or bottle-shaped, is subject to considerable variation due to contraction, expansion, and the influence of the strobila. Its structure is as simple as that of the cirrus,—two layers of muscle, one larger running longitudinally, the other at right angles to it and annular. Between the cirrus sac and the cirrus itself there is a parenchymatous tissue which completely fills the intervening space. It has been suggested that this loose tissue makes possible the movements of the cirrus in its sac. This seems plausible since the tissue is also permeated by muscle fibers. Moreover, the entire musculature of the cirrus sac is in direct connection with the surrounding tissue. Cross sections clearly show the connection of muscle fibers of the cirrus sac with both dorsal and ventral muscle fibers.

There are also retractor muscles present, seemingly attached at the posterior portion of the sac.

The cirrus is really a continuation of the vas deferens. It is highly muscular, being composed, like the cirrus sac, of a double muscular envelope of longitudinal and annular muscles. The wall of the cirrus seems to contain also a structureless membrane. Of the barbs, thorns and bristles mentioned by some authors, I could find no trace. When retracted, the cirrus is always convoluted. But these convolutions disappear when the organ is extruded. There seem to be no special retractor muscles. Retraction, then, would seem to be accounted for by the deturgescence of the loose parenchyma.

The female reproductive organs of *macrobothrium* consist of ovaries, oviducts, yolk glands and their ducts, shell glands and their ducts, and the vagina with the uterus.

The ovaries are glands that consist primarily of two sections connected by a middle piece. Each section resembles the expanded wings of a butterfly. Perhaps a better characterization would be to say that there is a dorsal and a ventral portion, so that a cross section of the entire organ would be represented by the letter H. (Fig. 9.) The position in the proglottis might be designated as the rear of the central field. The wings are connected only by the cross piece. The tubules are covered by a clear and apparently quite structureless membrane. The germ cells are small, with finely granulated protoplasm and large nucleus. Stained sections show the germ cells polyhedral but this is due to the pressure which they exert upon each other. In the oviducts, their outline appears oval or circular. The nucleus usually stains much deeper than the surrounding protoplasm. A nucleolus is occasionally demonstrable. This was first shown for *Calliobothrium corollatum* by Pintner as quoted by Braun. (2; 1421.) This nucleolus takes the stain about as the nucleus and appears as a crescent-shaped body in the larger germ cells. I failed to find it in any germ cells that seemed to be not yet fully developed.

The tubules of the lateral wings of the ovaries lead towards the central connecting piece. They become wider as they progress and unite in a hollow space in the connecting piece, whence the oviduct leads forward. Here a muscular apparatus is to be found, the purpose of which is to take up the liberated germ cells and to transport them onwards. Moniez, in 1881, (Bronn, 815) first called attention to this structure under the name of "Pavillon." The name "Schluckapparat" was introduced by Pintner, (Bronn, 1081) and has found general acceptance by German zoologists. There seems to be no good reason against its acceptance by English and American zoologists. There is no single English word which expresses so tersely, clearly and characteristically the function of this structure. Precedant for the adoption of a foreign word in our terminology is not lacking. I refer to only one well known example. It is the word "Anlage" which is in current use universally.

Two variations of "Schluckapparat" are known in Cestoda, one a simple one composed only of annular muscles, and the other more complex and adding longitudinal muscles to the annulars. In *macrobothrium* only the simple type is found.

The vagina (Fig. 6) can be traced from the ovary forward along the median line where it lies as a small tube with short sinuous curves to the base of the cirrus sac. It there turns abruptly towards the margin and, in some preparations, can be traced right along the cirrus sac. The vagina appears to open immediately beside the cirrus, between it and the margin. It will, therefore, be correct to say that the vagina opens right under the cirrus but a little dorsal to it.

The shell gland (Fig. 8) consists of a very large number of club-shaped glandular cells whose fine deferent tubules lead in the region of the yolk sac into the oviduct. The cells of the shell gland are developed all around the oviduct. The cells themselves show the nucleus in a homogeneous protoplasm. There is evidence of an investing membrane around each cell.

The direct prolongation of the oviduct beyond the shell gland is the uterus. It is presumed that its original purpose

was the transportation of the finished eggs. But the multiplication of the number of eggs formed necessitated an elongation and widening of the transporting canal. This was undoubtedly the origin of the turnings and twistings that we now find. By far the most important question concerning this structure is that which has to do with the uterine openings for the extrusion of the ripe eggs. The uterus may be considered as a tube consisting of three or more hardly distinguishable parts. The first portion is that which begins with the shell gland and runs along as a rather thin tube. Then comes a much wider and convoluted portion carrying eggs. During the period of sexual maturity this portion is so overdeveloped as actually to crowd all the other organs. The final portion is that tube which connects with the exterior. Now the question arises, is there a real preformed uterine opening or not? If there is no such opening, then we have to explain how the mature eggs reach the exterior. In *macrobothrium* there is certainly no indication of a preformed opening. An inspection of the ruptured segments, and especially of the ruptured margins, will make this plain. What really happens in our species is this. The uterus ruptures, and that always at a definite spot, which is the same for all segments, and is always in the median line and on the ventral surface of the segment. The bursting of the uterus might be occasioned by contact, or by chemical or mechanical stimulus, however light. It is very commonly known that a mere dipping of the strobila into water will cause a bursting of the uterus and the evacuation of the eggs in a veritable stream. If the ruptured wall of the segment be carefully examined, it will be seen that there is no histological basis for the assumption of a performed uterine opening. The tissues are simply torn asunder. The same tissues, in the same position and order, appear on either side of the tear. The two severed sides can be brought together and there will be not the slightest trace to show where they had been separated. The rupture takes place in the ventral surface because that is the location of the uterus.

In conclusion the following list of specific characteristics is offered for *Stenobothrium macrobothrium*, in so far as a preliminary study will warrant the drawing up of such a list.

(1) An anapolytic strobila with all the segments even the last wider than long.

(2) A pars bothridialis representing the most excessive elongation known among Tetrarhynchoids.

(3) A thick muscular band running medially throughout the entire length of the individual on both dorsal and ventral surfaces.

(4) A double layer of muscles at either end of each segment.

(5) A many-branched excretory system whose branches meet again as continuations,—the inclosed spaces forming islands.

(6) A complicated canal system of the excretory apparatus which discharges into a metameric bladder in each segment.

(7) A marginal genital cloaca, situated anteriorly and ventrally.

(8) The vagina opening beside the cirrus, under it and dorsal.

(9) No preformed uterine openings.

(10) Nucleoli in the larger germ cells.

EXPLANATION OF PLATES.

The entire ten figures refer to the same species,—*Stenobothrium macrobothrium*, Diesing. The host is *Carcharias lamia*.

The same letters refer to the same structures throughout.

A M——annular muscles
Bl——bladder
C S——cirrus sac
E——excretory system (main trunk)
e——excretory system (small trunk)
L M——longitudinal muscles
M M——median muscle
N——nerve
Ov——ovary
Schla——schluckapparat
Sg——shell gland
Te——testes
Ut——uterus
Vag——vagina
Vd——vas deferens
Yg——yolk gland

FIG. 1. Entire specimen preserved in alcohol. It is a young specimen and shows the primary end segment. Scale: value of one space 50 mm.

FIG. 2. Proglottids showing extruded cirri and uterine openings, median and in a straight line. Scale: value of one space 100 mm.

FIG. 3. Head. Illustration shows proboscides, bothridia and collar. Scale: value of one space .05 mm.

FIG. 4. Cross section through a proglottis showing nerve, large and small excretory branches, yolk gland and testes. The section shows especially the strong ring of annular muscle and the cut ends of longitudinal muscles. Scale: value of one space 0.01 mm.

FIG. 5. Cross section through the region of the excretory bladder. The section shows the musculature of the periphery as well as the muscles of the septum. MM shows the large typical median muscle with Bl, the bladder.

FIG. 6. A cross section through the region of the cirrus sac to show the relative positions of cirrus and vagina. In this region the uterus is entirely absent.

FIG. 7. A cross section showing the schluckapparat, Schla., with an ovum included. The section shows the relative positions of this organ, uterus and ovary.

FIG. 8. A cross section showing the position of the shell gland, sg.

FIG. 9. A cross section of a proglottis showing the typical H structure of the ovary. The descending ramus of the right side is so thin that only a single egg can pass at one time.

FIG. 10. A cross section showing the ruptured uterus.

(Scale for Figs. 4 to 10: value of one space 0.01 mm.)

Fig. 1.

Fig. 2

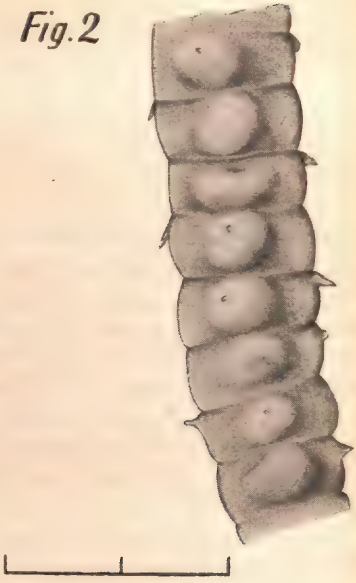
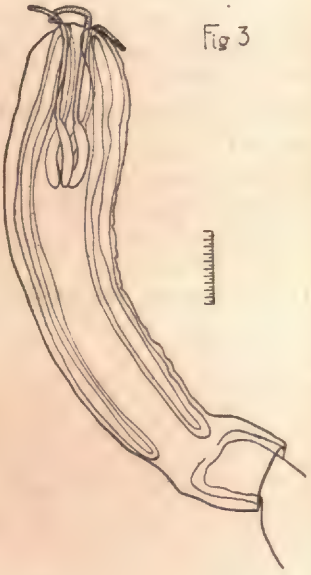


Fig 3



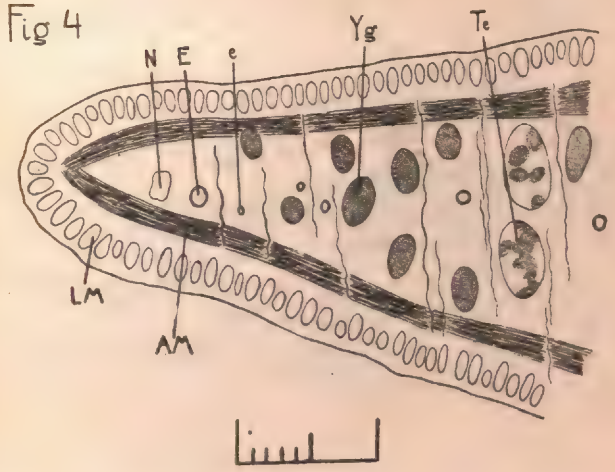


Fig 4
N
E
e
Yg
Te
LM
AM

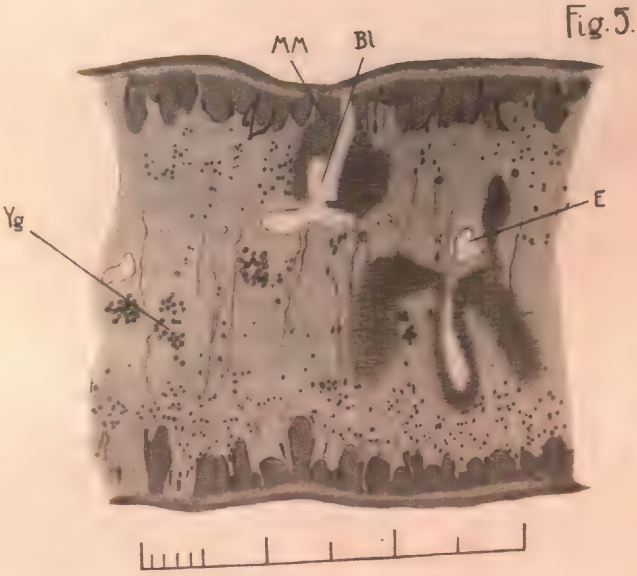


Fig. 5.
MM
Bl
Yg
E

Fig. 6.

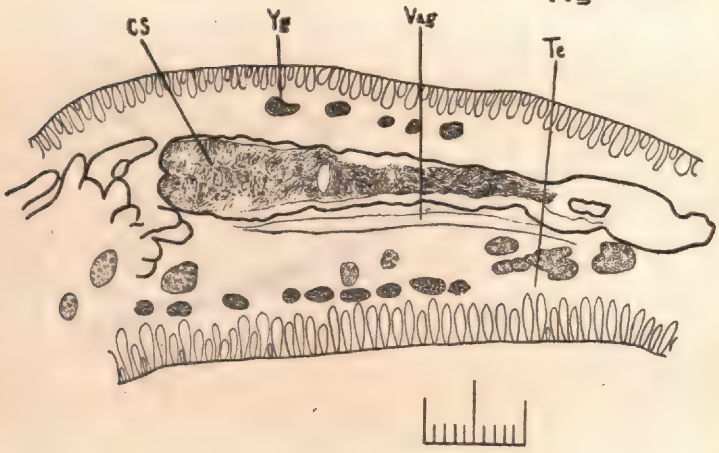


Fig. 7

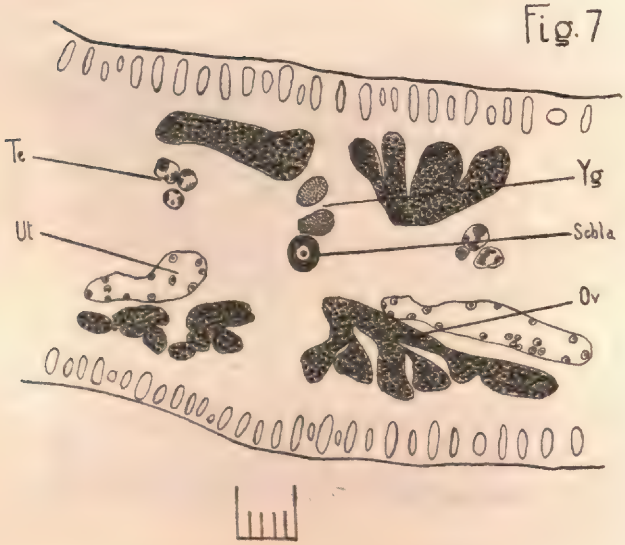


Fig 8.

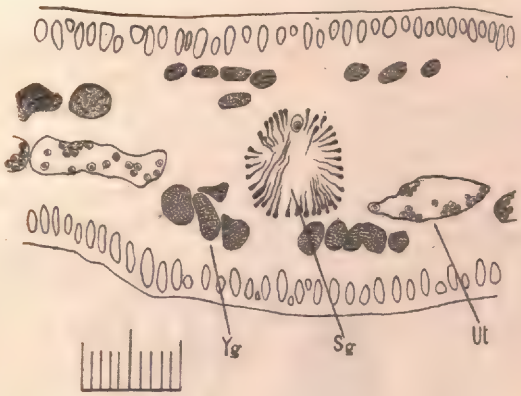
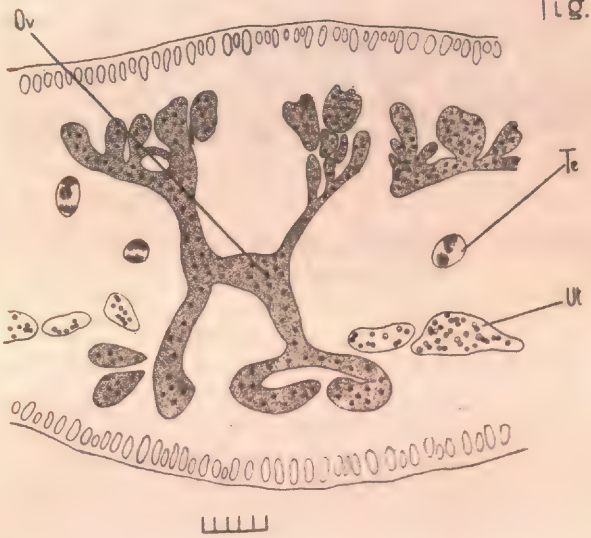


Fig.9.



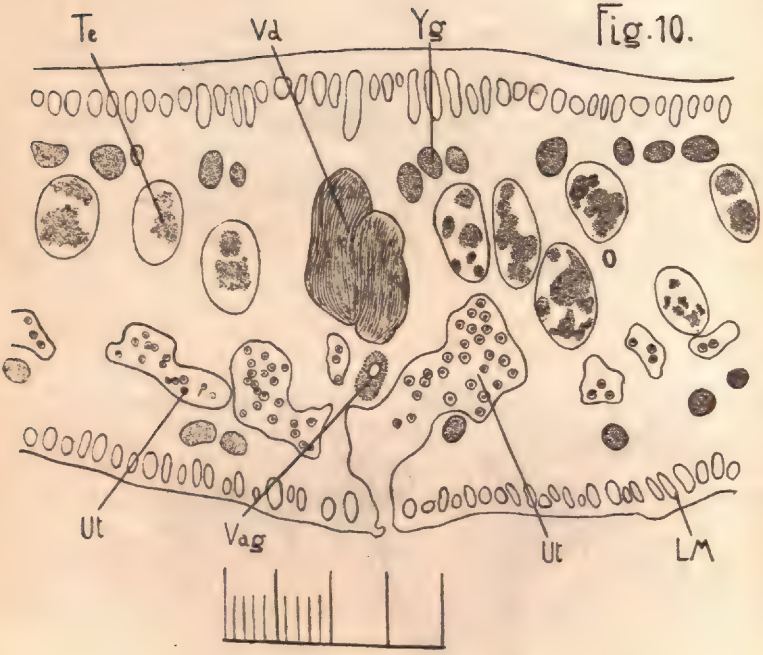


Fig. 10.

BIBLIOGRAPHY.

1. Baird, W.—Catalogue of the Species of Entozoa or Intestinal Worms contained in the Collection of the British Museum, London. 1853 . 8. 132 pg. with 2 pl.

2. Beneden, Ed. van—Recherches sur la composition et la signification de l'oef. Bruxelles 1870. 4. 283 pg. 12 pl. (Aus. Mem. de l'Acad. Roy. de Belg. Tom. XXXIV.)

3. Beneden, P. J. van—Notice sur un nouveau genre d'helminthe cestoide (Bull. de l'Acad. Roy. de Belg. T. XVI. 1. 1849. pp. 182-193 avec 1. pl. Ann. mag. hist. nat. 2. Ser. Vol. V. 1850. pp. 42-46. Frorieps Not. 3. Reihe. Bd. X. 1849. pp. 241-246.)

4. Beneden, P. J. van—Sur le development des Tetrarhynques (Bull. de l'Acad. Roy. de Belg. T. XVI. 1. 1849. pp. 44-52. L'Institut XVII No. 787. 1849. pp. 34. No. 798. pp. 126-127. Compt. rend. Acad. sc. Paris T. 28. 1849. pp. 156-157. Ann. sc. nat. 3. Ser. Zool. T. XI. 1849. pp. 13-18. Froriep's Not. 3. Reihe Bd. X. No. 206. 1849. pp. 113-117 und Müller's Arch. f. Anat. u. Phys. 1851. pp. 83-87.

5. Braun, M.—Die tierischen Parasiten des Menschen. 1 Bd. Leipz. 1925.

6. Braun, M.—Cestodes. In: Bronn, H. G., Klassen und Ordnungen des Tierreichs. IV., 2. Leipzig. 1897-1900.

7. Bremser, J. G.—Icones helminthum systema Rudolphi entozoologicum illustrantes. Viennae. 1824. 12 pg. fol. c. XVI tab.

8. Cobold, T. Sp.—Parasites, a Treatise on the Entozoa of Man and Animals, including some Account of the Entozoa. London 1879. 8. 510 pp. with 85 fig.

9. Creplin . . . . .—Artikel Eingeweidewürmer (Ersch u. Gruber's Encyclop. d. Wiss. und Künste. Th. 32. Leipzig 1839. pp. 277-302.)

10. Diesing, C. M.—Systema helminthum. Vol. I. Vindobonae 1850.

11. Diesing, C. M.—Uber eine naturgemässe Verteilung der Cephalocotyleen (Sitzber. d. K. Akad. d. Wiss. math.-nat. Cl. Bd. XIII. Wien 1854. pp. 556-616.)

12. Diesing, C. M.—Revision der Cephalocotyleen. In: Sitzber. d. K. Akad. d. Wiss. Wien. math. nat. kl. 43., 200-430. 1863.

13. Diesing, C. M.—Revision der Cephalocotyleen (Sitzber. d. K. Akad. d. Wiss. Wien. Math.-nat. Cl. Bd. 48. I. 1863. pp. 200-345 und Bd. 49. I. 1864. pp. 357-430).

14. Drummond, J. L.—Notices of Irish Entozoa. (Charlesworth's

Mag. of Nat. Hist. N. Ser. Vol. II. 1838. pp. 515-524, 571-577, 655-662. Ann. d. sc. nat. II. ser. Zool. T. X. Paris 1838 pp. 128.)

15. Dujardin, F.—Histoire naturelle des helminthes ou vers intestinaux. Paris. 1845. avec 12 pl. 8.

16. Eysenhardt, K. W.—Einiges über Eingeweidewürmer (Verhandl. d. Ges. naturf Erde. Berlin. Bd. I. 1829. pp. 144-152).

17. Leblond, Ch.—Quelques observations d'helminthologie (Ann. d. sc. nat. 2 ser. Zool. Tom. VI. Paris 1836. pp. 289-307. pl. XVI).

18. Leuckart, R.—Die Parasiten des Menschen. 2 aufl. Bd. L. Lief. 2. Leipzg. 1881. 387-856.

19. Lidth de Jeude, Th. van.—Recueil de figure des vers intestinaux. Leide. 1829. 11 pl. fol.

20. Linstow, v.—Neue Beobachtungen an Helminthen (Arch. f. Naturg. 44 Jahrg. 1878. Bd. I. pp. 218-245 mit 3 Taf).

21. Linton, Edwin—Notes on the Entozoa of Marine Fishes of New England, etc. Ann. Rep. Comm. Fish & Fisheries. 1886., 450-498, 1889.

22. Linton, Edwin—Notes on Larval Cestode Parasites of Fishes. In: Proc. U. S. Natl. Mus. Vol. XIX. pp. 787-824. (No. 1123) Wash. 1897.

23. Linton, Edwin—Notes on Cestode Parasites of Fishes. Proc. U. S. Natl. Mus. 20, 423-456. 1897.

24. Linton, Edwin—Parasites of Fishes of the Woods Holl Region. Bull. U. S. Fish Comm. for 1899. pp. 405-492. Wash. 1901.

25. Linton, Edwin—Parasites of Fishes of Beaufort, North Carolina. Bull. Bureau of Fish. for 1904. Vol. XXIV. pp. 321-428. Wash. 1905.

26. Linton, Edwin—Notes on the Distribution of Entozoa of North American Marine Fishes. Proc. 7th. Internatl. Zool. Congr. 1907, Cambridge, Mass. 1910.

27. Linton, Edwin—Notes on Cestode Parasites of Sharks and Skates. Proc. U. S. Natl. Mus. Vol. 64. Art. 21. pp. 1-114. Wash. 1924.

28. Miescher . . . .—Uber Verwandlungen der Entozoen (Froriep's Neue Notizen a. d. Geb. d. Natur- u. Hlkde. Bd. XXI. Weimar 1842. No. 20 (460) pp. 310-312. Berichte d. naturf. Gesellsch. Basel. 1840. pg. 29.

29. Nitzsch . . . .—Artikl Bothriocephalus (Ersch und Gruber, All. Encycl. d. Wiss. und Künste. Bd. XII. 1824. pp. 94-99).

30. Nordmann, M. V.—Uber Tetrarhynchus (Zeitsch. f. wiss. Zool. Bd. IV. 1853. pp. 451-453).

31. Pintner, Th.—Untersuchungen über den Bau des Bandwurmkörpers mit besonderer Berücksichtigung der Tetrabothrien und Tetrarhynchen (Arb. a. d. Zool. Inst. d. Univ. Wien. T. III 1881. pp. 163-242 mit 5 Taf. Abstr. in: Journ. R. Micr. Soc. (2) Vol. I. pp. 458-460).

32. Pintner, Th.—Vorarbeiten zu einer Monographie der Tetrarhynchoideen. In: Sitzber. K. Akad. Wiss. Wien. math. nat. kl. 122, Abt., 1-83. 1913.

33. Pintner, Th.—Bemerkenswerte Strukturen im Kopfe von Tetrarhynchoideen. In: Zeitschr. f. wiss. Zool. 125, 1925.

34. Pintner, Th.—Topographie des Genitalapparates von Eutetrarhynchus rufficolis (Eysenhardt). In: Zool. Jahrb. Anat. 47, 212-245. 1925.

35. Pintner, Th.—Helminthologische Mitteilung I. In: Zool. Anz. 76, 318-322. 1928.

36. Rudolphi, C. A.—Entozoorum sive vermium intestinalium historia naturalis Amsteldami. Vol. II. 1869.

37. Rudolphi, C. A.—Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi. Berolini. 1819. p. 142. pp. 485-486.

38. Sanders, A.—On an Undescribed Stage of Development of Tetrarhynchus corollatus (Monthly Micr. Journ. Vol. III. 1870. pg. 72-74 with 1. pl.)

39. Siebold, C. Th. v.—Ueber den Generationswechsel der Cestoden nebst einer Revision der Gattung Tetrarhynchus. (Zeitschr. f. wiss. Zool. Bd. II. Leipzg. 1850. pp. 198-253 mit 2 Taf. Uebers in Ann. de sc. nat. 3. ser. Zool. T. XV. 1851. pp. 176-244 avec 1. pl.)

40. Siebold, C. Th. v.—Ueber die Band und Blasen Würmer nebst einer Einleitung über die Entstehung der Eingeweidenwürmer. Leipzg. 1854. 115. pg. 8 mit 36 Holszch. (Uebers in Ann. d. sc. nat. 4 ser. Zool. Tom. IV. 1855. pg. 48-90; 172-200 avec 2 pl.)

41. Wagener, G.—Enthelminthica. I. Ueber Tetrarhynchus (Müller's Arch. f. Anat. Phys. Jahrg. 1851. pp. 211-220 mit 1 Taf.)

42. Wagener, G.—Enthelminthica III. (Müller's Arch. f. Anat. u. Phys. Jahrg. 1852. pp. 555-569 mit 1 Taf.)

43. Wedl, K.—Helminthologische Notizen (Sitzber. d. K. Akad. d. Wiss. math.-nat. Cl. Bd. XVI. Wien. 1855. pp. 371-395 mit 3 Taf).

EQUISETITES IN POSITION OF GROWTH IN THE SUNDANCE LIMESTONE.[1]

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I. INTRODUCTION.

Whilst examining the lower beds of the Sundance Formation near Thermopolis, Wyoming, my attention was attracted by a thin bed of limestone, perforated at right angles to the bedding by numerous tubular holes. These holes are generally 0.5 cm. or a little less in diameter, and are spaced at about 16 per square decimeter. At first glance they might be mistaken for worm burrows, but several peculiarities led me to suspect that they were not of that nature. In the first place, although most of the holes are about 0.5 cm. in diameter, they include quite an appreciable number of much smaller ones; on closer examination it was seen that narrow, thread-like holes branch out horizontally from the larger vertical ones. Secondly, the spacing of the larger holes is fairly regular—more so than would be expected in the case of worm

[1] These observations were made during the 1928 American Trip of the Princeton Summer School of Geology and Natural Resources, this paper being Contribution No. 6 of the School.

burrows. Thirdly, the bed has a very strong resemblance in appearance to certain plant bearing rocks which are familiar in delta deposits, for example, the "pencil gannister" of Yorkshire, England. This last resemblance was so striking that it led me to examine the limestone for recognizable traces of plants, and after a brief search, I found a thin layer in which the recumbent stems of a species of *Equisetites* were preserved in abundance.

The limestone with *Equisetites* lies at the base of the Sundance, and forms the crest of the ridge between the outcrops of the Chugwater Red Beds and the overlying shales of the Sundance Formation. The details of the section are as follows:

Section at the Base of the Sundance Formation near Big Horn Hot Springs, Thermopolis, Wyoming.

3.	Fine grained, thin bedded limestone, with broken shells of Gasteropods at the base		4′ 6″
		c. Limestone with vertical holes	1′ 2″
2.	Equisetites Bed.	b. Layer with vertical stems of *Equisetites*	— —
		a. Limestone with vertical holes	0′ 5″
1.	White limestone, fissile at the top, about		3′ 0″
	Chugwater Red Beds (contact unexposed)		

The full section at Big Horn Hot Springs has been measured and described by W. T. Lee.[2] The contact between the lowest member of the Sundance Formation (Jurassic), and the top of the Chugwater Red Beds (Triassic), was not seen at the spot where the specimens of *Equisetites* were collected; the basal bed (No. 1 in the section above) can hardly be more than a few feet thick, however. The actual contact

[2] W. T. Lee: Correlation of Geologic Formations between East-Central Colorado, Central Wyoming, and Southern Montana; U. S. G. S. Professional Paper No. 149, p. 57, 1927.

is discussed by Lee in the light of evidence from other exposures, and is thought to be unconformable.[3]

The bed which contains the vertical markings produced by *Equisetites* is a rather rough textured but well bedded limestone. The layer with recumbent aerial stems is about five inches from the base of the bed, and in places may be seen to be resting upon a surface of mud-cracks, filled in with a white pasty limestone. The presence of the Gasteropod *Neritina* (if it is correctly identified)[4] in the limestone immediately above the plant remains is strong evidence of brackish water or alongshore conditions. Although no shell fragments have been found in the beds numbered 1 and 2, the preservation of desiccation cracks and the undisturbed character of the sequence suggests that the conditions of formation of the sediment of these beds cannot have been much different from those which held during the formation of bed 3, and the environment was essentially the same. Thus, although the plants may have grown in an ooze not completely saturated with brackish water, or even on an emerged flat, their environment was maritime and not inland.

II. DESCRIPTION OF PLANT REMAINS.

The material available is not sufficiently complete for specific determination, but the fragments at hand are characteristic enough to leave no doubt that they belong to a species of *Equisetites*. This name is used in the absence of cones, internal structure, or other diagnostic features, since the stem impressions alone do not warrant inclusion in the genus *Equisetum*, which implies a very definite structure of the reproductive shoots and of the tissues of the stem. The generic name *Equisetites* was proposed by Sternberg[5] as a designation for fossil stems bearing a close resemblance to

[3] W. T. Lee: ibid., pp. 15 and 16.

[4] W. T. Lee: ibid., p. 57.

[5] Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt, Fasc. VIII, p. 43. Leipzig, 1838.

recent species of *Equisetum*,[6] to which category the material under discussion naturally belongs.

The *Aerial Shoots* are represented by impressions of flattened stems. In the most complete specimen (No. 205, Fig. 4), which shows three nodes, the width of the stem is 1.3 cm. and the distance between successive nodes is 1.9 cm.

The *Leaf Sheath* consists of twenty or more sharply pointed segments, 0.9 cm. long in specimen 205 and 1.4 cm. in number 206; they are free for about half of their length. In many of the specimens the impression of a single vein can be made out. The actual position of the node is not always distinctly visible in the specimens available, and the conspicuous markings on the impressions are tips of the leaf sheaths.

The *Vertical Underground Shoots* are generally 0.3-0.5 cm. in diameter, and are preserved as cylindrical pipes, sometimes filled in with a white or pale buff powdery limestone, but are frequently found as empty cavities in the rock. The tubes occasionally show constrictions, which may indicate the positions of nodes. Roots are given off at right angles to the vertical shoots, and are generally preserved as narrow, thread-like holes in the limestone. (See Fig. 1.) Horizontal rhizomes and tubers were not observed.

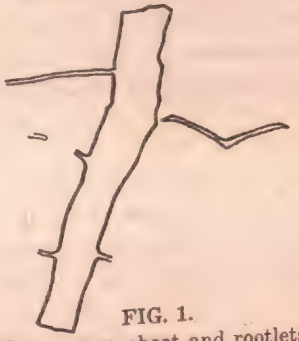

FIG. 1.

Equisetites, sp. Subterranean shoot and rootlets exposed on the fractured surface of the rock. Specimen No. 202, x1.5.

[6] See also Seward, Fossil Plants, Vol. I, p. 257, 1898.

From the manner in which these fossils occur in the rock, there can be little doubt that they were actually growing on the spot where they are now found. There is no trace of soil, and the roots run out into a matrix which, on analysis, is found to be 90-93 per cent fine grained calcium carbonate, and must have been a soft carbonate ooze when the plants were growing—otherwise it could not have preserved their impressions.

III. COMPARISON WITH THE VEGETATION ON MODERN DREWITE FLATS OF THE BAHAMAS.

The main point of interest which this occurrence of *Equisetites* presents is the close resemblance between the conditions under which the plants must have grown at Thermopolis in Jurassic times, and the peculiar conditions under which various plants, especially the Mangrove, *Rhizophora mangle* L., grow at the present day on certain islands on the Great Bahama Bank.

The Bahama Bank forms a large area of shallow water (for the most part ten to fifteen feet deep) completely surrounded by deep water.[7] The marine deposits of the Bank are entirely calcareous, and consist largely of Drewite, a very pure and fine grained calcium carbonate mud. Large areas of the islands on the Great Bahama Bank are formed of raised deposits of the same material. The western part of Andros, and the two small islands, Billy and Williams, which lie to the west of Andros, are devoid of soil, and are covered with a glaring white, heavily sun cracked surface of Drewite. Through this deposit the Mangroves grow (see Fig. 6), and where they are colonizing new ground, the underground rhizomes send up a thick growth of new shoots, about the size of pencils. (See also the figure on p. 53 of Agassiz's paper.)

[7] For descriptions of the Great Bahama Bank, see Alex. Agassiz, Bull. Mus. Comp. Zool. at Harvard Coll., Vol. XXVI, No. 1, pp. 17-62, esp. pp. 50-56, 1894; R. M. Field, Am. Journ. Sci., Vol. XVI, No. 93, pp. 239-246, 1928.

This is the state of affairs over the botanical region known as the "swash" or "marl"[8] which includes most of the Western half of Andros Island, and the smaller islands immediately to the west. The resemblance between these stretches of soil-less Drewite with their vertical mangrove shoots, and the Sundance limestone at Thermopolis, with its vertical shoots of *Equisetites*, is very close.

It has been suggested that, since modern species of *Equisetum* secrete considerable quantities of silica, and related Jurassic plants may have done the same, the latter would have been in difficulties through growing in a medium consisting largely of calcium carbonate. It may be pointed out that the silica must enter the plant in solution, whatever the environment may be; and since there is sufficient silica in solution in sea water to provide material for the skeletons of siliceous organisms[9] there would no doubt be enough to satisfy the demands of *Equisetaceous* plants. It is also perhaps worth mentioning that Drewite is over 99 per cent, whilst the limestones at Thermopolis range between 90 and 93 per cent calcium carbonate.

IV. COMPARISON WITH THE OCCURRENCES OF EQUISETITES IN SILTY BEDS OF JURASSIC AGE.

A comparison which at first sight seems remote, but is perhaps actually of some significance, is with the similar manner in which other species of the same genus occur in shaley and silty beds. In the delta deposits of the Middle Jurassic of Yorkshire, England, are numerous beds of silt which con-

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[8] The botanical regions of Andros Island are discussed by Mrs. Northrop in The Flora of New Providence and Andros, Mem. Torrey Botanical Club, Vo. XII, No. 1, pp. 4-8, 1902; and by Small and Carter, Report on Botanical Exploration in Andros, Bahamas, Journ. N. Y. Bot. Garden, ol. XI, No. 124, pp. 88-101, 1910.

[9] There also is evidence on some parts of the Bank to show that silicification of calcareous material has taken place on land, showing the presence of silica locally in the ground water.

tain stems and roots of *Equisetites columnaris* Brongn. and *E. beani* (Bunb.) in the position of growth.[10] The remains of the plants are found as vertical pencil-like rods in the laminated silts through which they grew, and also as flattened recumbent stems. These silts have a very characteristic appearance, which is closely parallelled by that of the *Equisetites* Bed in the Sundance formation, and the conditions may, to some extent at least, have been comparable. There is little previous evidence to show that plants of this genus grew either in a salt water or a marine tide flat environment, or in carbonate oozes. All the associations of these fossils have been presumed to be with fresh water or terrestrial plants, though in some cases the communities may be better interpreted as those of a salt marsh. For example, Dr. Hamshaw Thomas[11] has shown on physiological and ecological grounds that some of the plant beds of the Yorkshire Estuarine Series are probably the remains of salt marsh communities, and it is possible that some of the beds of the same age which contain nothing but *Equisetites* may have originated similarly. Dr. Halle has definitely made this suggestion in describing an occurrence of upright stems and horizontal rhizomes at Ravenscar, Yorkshire. He is of the opinion[10] that "*Equisetites* grew in large, shallow, fresh or brack-water lagoons or protected estuaries with low marshy shores . . ." If this be so, the parallel is even closer, although the remarkable fact remains that in one case the plants grew in a fine argillaceous mud devoid of lime, and in the other they grew in a fine grained mud consisting largely of calcium carbonate.

I am much indebted to Mr. J. Bridge and Mr. J. T. Sanford of the Department of Geology, Princeton University, for preparing the photographs for this paper, and to Mr. W. N.

[10] For description and figures of a typical example, see Halle, Geol. Mag., pp. 3-7, 1913; and Kendall, Geol. Mag., pp. 7-9, 1913.

[11] In his Sedgwick Prize Essay on the Yorkshire Estuarine Series (unpublished).

Edwards of the British Museum (Natural History), for reading the manuscript and making several suggestions.

EXPLANATION OF FIGURES

Figs. 2 and 3.—Limestone with vertical holes (subterranean shoots of *Equisetites.*) 2. Vertical section, showing form of shoots. Specimen No. 203 x5/6. 3. Cross section, parallel with the bedding, showing spacing of the holes. Specimen No. 204 x 0.5.

Fig. 4.—*Equisetites* sp. Stem impression showing three nodes and internodes. Specimen No. 205 natural size.

Fig. 5.—*Equisetites* sp. Single node and leaf sheath. Specimen No. 206 x 5/3.

Fig. 6.—View of the "swash" or "marl" region, Williams Island, Bahamas. The bushes are half-grown Mangroves, and the pencil shaped shoots grow from rhizomes of these plants. This is typical of the islands on the central part of the Great Bahama Bank.

Fig. 7.—Detailed view of the surface of the ground in the "swash" of Williams Island, showing the complete absence of soil on the sun cracked surface of Drewite.

FIGURES 2-5

FIGURE 6

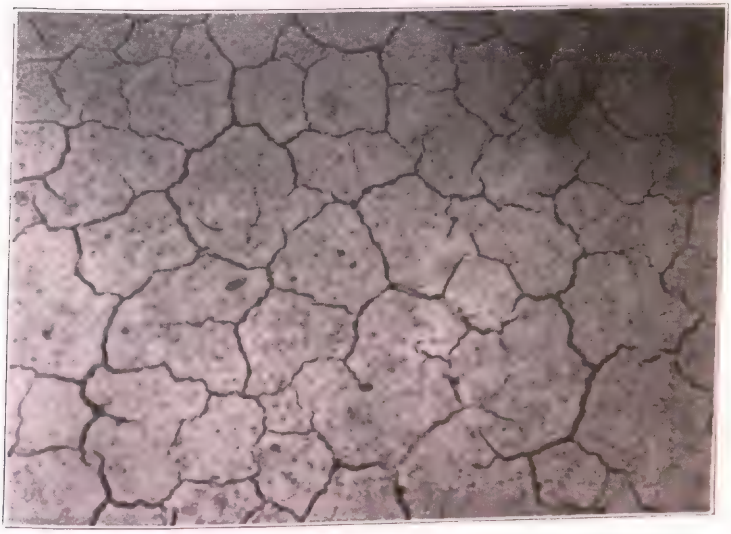

FIGURE 7

The American Midland Naturalist

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THE MEXICAN SPECIES OF TILIA.

BENJAMIN FRANKLIN BUSH.

The first reference to the genus *Tilia* in Mexico I have been able to find, is by Schlechtendal in Linnaea *11*: 377. 1837, where he described *Tilia mexicana*, collected by Schiede, and gives as the type locality "Cuesta grande de Chiconquiaco."

Schiede probably collected his specimens the year preceding the publication of *T. mexicana*, and for nearly three-quarters of a century no other species of Tilia was known from Mexico, everything that was collected being referred to this species, which no one seemed to know anything about.

In 1905 Rose[1] described two species of TILIA from Mexico, *T. occidentalis* and *T. Houghii*, and in 1906 distributed two others under the names *T. Pringlei* and *T. cordata*, apparently intending to publish them, but did not.

There are now five species of *Tilia* indicated for Mexico, either published or distributed under herbarium names with specimens, including *T. cordata* Rose, a species no one seems to have taken up, but which is evidently a Mexican species, whatever it may be.

[1] J. N. Rose, Contrib. U. S. N. Herb. *8*: 4. 317 and 318. 1905.

Engler[2] in his Monograph of the genus TILIA, treats Schlechtendal's *T. mexicana* as a good species, which he says was collected by Schiede at "Cuesta grande de Chiconquiaco," in the State of Nuevo Leon.

Engler promptly reduces Rose's *T. occidentalis* and *T. Houghii* to varieties under *T. mexicana,* and makes Rose's unpublished *T. Pringlei* a form under this variety *Houghii,* saying that it was the exact equivalent of *T. mexicana,* thereby leaving nothing to stand for the species *T. mexicana,* which seems to me to be like trying to picture a tree by drawing the branches only, or building a house without a foundation.

Sargent[3] in his TILIA paper mentions *T. mexicana* as being collected near Chiconguiaco, State of Hidalgo, and refers some specimens collected by Dr. Palmer under No. 118, to *T. floridana,* but this No. 118 of Dr. Palmer's collection proves to be a mixture of several species.

Standley[4] in his Trees and Shrubs of Mexico, recognizes four species of TILIA, and he admits that nothing is known of *T. mexicana,* which he says came from Cuesta Grande de Chiconquiaco, State of Veracruz. By the very fact of Standley capitalizing the adjectival term "grande," shows conclusively that he thought the type locality as given by Schlechtendal was a town.

From the above it will be seen that *Tilia mexicana* has had a varied experience, the Cuesta grande de Chiconquiaco being located in three different States, and regarded as a town by Engler, Sargent and Standley.

As I understand Schlechtendal's account of *T. mexicana,* the sentence Cuesta grande de Chiconquiaco is *"on a broad slope of (Mount) Chiconquiaco,"* in parenthesis mine, which undoubtedly is a mountain somewhere in Mexico, and as there is a town named Chiconquiaco not far west of Veracruz, State

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[2] V. Engler, Monographic du Gattung TILIA, 125 and 126. 1909.
[3] C. S. Sargent, Notes on North American Trees, *3*: 434. 1918.
[4] P. C. Standley, Contrib. U. S. N. Museum, *23*: part 3. 735. 1923.

of Veracruz, it is presumable that the town takes its name from the mountain of the same name not far away.

Much of the ignorance of Mexican species of TILIA is due to the fact that there have been but few collections of TILIA made in Mexico, and these few collections are scattered throughout the country in various herbaria and collections and mostly in Europe. Even in Mexico, to where I applied for the loan of material, Prof. Herrera kindly wrote me that they have no material of TILIA from Mexico in their collection, and that he was unable to enlighten me further about *T. mexicana* than the original publication of Schlechtendal. Several Universities, to whom I have written about getting material from Mexico, advised me that they did not have a single specimen of TILIA from Mexico.

Many years will elapse before we can have any knowledge of the species of TILIA of Mexico, as we have known some of the most distinct species in North America for over a century before we knew their names, and there are still species here that are not yet named.

In order to understand the species of TILIA fully, it is necessary to collect from the same tree at least four times in the same season, once as the flowers are just in bud, that we may see what characters the unfolding leaves have, once when in full flower, which will show if they are large or small, again in mature fruit that its characters may be shown, and last a leading shoot in the Fall to show whether it is glabrous or pubescent, and whether the leaves thereon are likewise glabrous or pubescent. Not until this is done, can we expect to make any progress in the study of the Mexican species.

I have examined about 50 sheets of TILIA collected in Mexico, nearly all of which were labeled *T. mexicana*, but I did not find a single specimen of that species in the lot, and I was unable to refer all of the material examined to the other three species described by Standley in his Trees and Shrubs of Mexico.

I feel very confident that when more and better material

is collected, there will be other species found than the fifteen I now rcognize and describe.

It is much to be deplored that this lot of material that I have now examined and studied should not be all deposited in some one institution where any one who becomes interested in the TILIA species of Mexico could see what I have done, and have a better idea of the species, than just by seeing the few specimens any one institution has.

For the privilege of having so many Mexican specimens of TILIA to study, I am under obligations to Dr. Maxon of the United States National Herbarium, Dr. Rehder of the Arnold Arboretum,, Dr. Rosendahl of the University of Minnesota, Dr. Pammel of the Iowa State College, Dr. Standley of the Field Museum of Natural History, and Mr. Chas. C. Deam of Bluffton, Indiana, all of whom have been most obliging in placing at my disposal these specimens, and have also assisted me in many other ways, all of which I highly appreciate.

To facilitate the placing of specimens of TILIA, I submit the following:

KEY TO MEXICAN SPECIES.

Leaves glabrous below at maturity.

Axillary tufts of tomentum wanting; leaves mostly less than 10 cm. long; lateral nerves 3 or 4 pairs. 1. TILIA MEXICANA.

Axillary tufts of tomentum present; leaves mostly more than 10 cm. long; lateral nerves 5 to 7 pairs. 2. TILIA FLORIDANA.

Leaves not glabrous below, more or less scabrous, stellate-pubescent, tomentose or velvety below (in No. 9 becoming glabrescent) at maturity.

Leaves thin in texture.

Leaves minutely scabrous or thinly stellate-pubescent below, the principal veins on the lower surface of the leaves appressed-scabrous, ovate, ovate-oblong distantly serrulate with small teeth; petioles 2.5-3 cm. long. 3. TILIA PRINGLEI.

Leaves pubescent or stellate-pubescent below.

Leaves small, ovate, obovate or oblanceolate, mostly less than 8 cm. long, long-acuminate at the apex, grayish-pubescent, sharply apiculate-serrate; petioles 2-3 cm. long.

4. TILIA AMBIGUA.

Leaves medium-sized or large.

Leaves medium-size, mostly over 10 cm. long, round or round-ovate, deeply cordate at the base, minutely serrulate all around; petioles 2-3 cm. long. 5. TILIA ROTUNDA.

Leaves large, mostly 12-15 cm. long.

Leaves orbicular or round-oval, deeply cordate at the base, very thin, finely pubescent below, coarsely serrate or dentate; petioles 3-4 cm. long. 6. TILIA COAHUILANA.

Leaves not shaped as above.

Leaves ovate, olong-ovate or round-ovate cordate, tapering to a long acute point, serrulate nearly all around with sharp apiculate teeth; petioles rather long, slender. 3-4 cm. long. 7. TILIA NELSONI.

Leaves round ovate, obliquely truncate at the base, densely and finely pubescent below, sharply serrate all around with long slender teeth; petioles very long, slender, 5-6 cm. long. 8. TILIA LONGIPES.

Leaves thick in texture.

Leaves brownish-hirsute or tomentose below at first, more or less glabrate at maturity, round-ovate, obliquely truncate or truncate-cordate, mostly less than 8 cm. long, coarsely serrate nearly all around; petioles 3-4 cm. long, stout, covered with spreading brownish hairs. 9. TILIA OCCIDENTALIS.

Leaves softly-tomentose, velvety-tomentose or velvety.

Pubescence mostly tomentose, long and spreading on the stems, finer on the lower leaf surface.

Leaves densely grayish stellate-tomentose below, nearly orbicular in outline, oblique at the scarcely subcordate base, sharply serrate nearly all around; petioles short, stout, 2-2.5 cm. long, densely clothed with loose grayish pubescence. 10. TILIA HOUGHII.

Leaves with a finer yellowish stellate-pubescence, round-ovate, cordate at the base, minutely serrulate nearly all around, 10-18 cm. long; petioles long, stout, 3-4 cm. long, densely pubescent with fulvous spreading pubescence. 11. TILIA MORELIANA.

Pubescence closely velvety-tomentose below.

Leaves small, less than 10 cm. long, round-ovate, oblong-ovate deltoid-ovate, very oblique at the base, often truncate, yellowish below with a fine close tomentum, minutely serrulate or dentieulate all around; petioles short, stout, 2-2.5 cm. long, clothed with yellowish or brownish tomentum like the midvein. 12. TILIA SARGENTIANA.

Leaves medium-sized or large, mostly over 10 cm. long.

Leaves less than 12 cm. long, of medium size.

Leaves round-ovate, tapering to a long acute point, less than 12 cm. long, densely grayish-pubescent and velvety below, sharply serrate with broad apiculate teeth nearly all around; petioles rather long, very slender, 3-4 cm. long. 13. TILIA ROSEANA.

Leaves ovate, broad-ovate, or ovate-oblong, about 10 cm. long, densely brownish-velvety below, minutely serrulate on the margins, or nearly entire; petioles rather long, stout, 3-4 cm. long. 14. TILIA PERTOMENTOSA.

Leaves large, well up to 14 cm. or more, round-ovate, subcordate at the base, densely grayish stellate-tomentose below, obscurely serrulate all around or nearly entire; petioles very short, stout, 1-2.5 cm. long, densely clothed with yellowish hirsute tomentum. 15. TILIA ARSENEI.

1. TILIA MEXICANA Schlecht. Linnaea *11*: 37. 1837.

TYPE LOCALITY: Cuesta grande de Chiconquiaco (Veracruz.)

Type locality according to Engler, Cuesta grande de Chiconquiaco, Nuevo Leon.

Sargent gives type locality as near Chiconguiaco, Hidalgo.

Standley says the type was from Cuesta Grande de Chiconquiaco, Veracruz.

T. pubescens Bayer, in Verh. Zool. Bot. Ges. *12*: 56. 1862, according to Engler, l. c. 125, not *T. pubescens* Ait. Hort. Kew. 1789, which is *T. caroliniana* Mill., one of the *pubescentes*, while *T. mexicana* Schlecht is a *glabrata*, which is evidently a mistake on the part of Engler.

Michoacan, Oaxaca, Morelos and Nuevo Leon, Engler, l. c. 125, but there are no specimens to support any of these citations.

"Leaves very oblique at base, not cordate, 10 cm. long and 6 cm. wide or smaller, short-acuminate, with very acute gland-tipped teeth," ex Standley, l. c. 735.

Engler in his treatment of *T. mexicana*, the oldest and for three-quarters of a century the only species known for Mexico, splits this species into two varieties and one form, leaving nothing to stand for Schlechtendal's species. It is inconceivable to me how a species can be made a form of itself, leaving nothing to represent the typical form, which seems to be another case of the snake swallowing itself by beginning at the tail.

As there is no English or Latin description known of *T. mexicana*, I append the following abbreviated description of Schlechtendal:

"Winter-buds small and glabrous; leaves ovate-lanceolate, very much oblique and one-sided at the base, 10 cm. long or less, 6 cm. wide or less, the apex short and narrow, smooth on both sides (nor by any degree barbed in the axils), with two to three pairs of primary veins, acutely serrate with gland-tipped teeth; petioles 3 cm. long or less; bracts tolerably wide; cymes few-flowered; fruits large, the size of a large pea, grayish with dense appressed and slender tomentum," ex Schlechtendal.

SPECIMENS EXAMINED: No specimens of this species except the type collection are known.

2. TILIA FLORIDANA Small, Fl. S. E. U. S. 1335, 1903.
TYPE LOCALITY: Jackson County, Florida.

"Leaves 7-12 cm. long, 5-7, 5 cm. wide, short-acuminate, serrate with abruptly acuminate teeth, the lower surface at first with a few scattered stellate hairs, but soon glabrous; bracts long-pedunculate; petals 6-7 mm. long; fruit about 8 mm. long, densely tomentulose," ex Standley.

Coahuila, *Palmer* 118, 1880, as *T. mexicana*, is referred to *T. floridana* by Sargent in TILIA, l. c. 434.

Monclova, *Palmer* 118, August 19, 1880, as *T. mexicana*, is referred to *T. floridana* by Sargent in *Tilia*, l. c. 434.

Northeastern Mexico, Sargent, l. c. 738, referring of course to Palmer's No. 118, but this No. 118 of Palmer's collection is a mixture of several species.

Chihuahua, Coahuila and Nuevo Leon, according to Standley, l. c., 735, but no specimens are known from Chihuahua and Nuevo Leon.

3. TILIA PRINGLEI Rose, n. sp. in Sched. 1906.

T. mexicana Houghii forma *Pringlei* (Rose) Engler, Monog. TILIA: 126. 1909.

T. mexicana Schlect., according to Engler, l. c., 126, but certainly a mistake on the part of Engler.

TYPE LOCALITY: Monterey, Nuevo Leon.

Twigs grayish, slender; winter-buds reddish-gray, ovate, plump, pointed, scantily pubescent above, 3-4 mm. long; leaf-blades ovate, ovate-oblong or broadly ovate, tapering to a blunt or somewhat acute point, 6-15 cm. long, 5-10 cm. wide, distantly serrulate with rather small not sharp teeth, dark green and glabrous above, somewhat lighter and minutely scabrous or stellate-pubescent below, the principal nerves on the lower surface of the leaf yellowish, conspicuous, and appressed-scabrous, with tufts of yellowish tomentum in the axils; petioles slender, long, 2.5-3 cm. long, minutely scabrous or nearly glabrous; bracts very large, 7-15 cm. long, 1-2 cm. wide, tapering at the base, broader above, the stalk 2-3 cm. long, glabrous on both sides, conspicuously reticulated, much shorter than the cymes and flowers; peduncles very slender, grayish, 2-4 cm. long, minutely pubescent; pedicels slender, 5-8 mm. long; cymes rather large, or medium sized, many-flowered; branches of the cymes, pedicels and sepals minutely grayish-tomentose; flowers small, 4.5-5 mm. long.

I can not understand why Engler should take up Rose's

name for *T. mexicana* when he knew that Schlechtendal's name was valid, and had priority over Rose's name, if the two are the same, which I am quite sure they are not.

SPECIMENS EXAMINED: Wet canyons, Sierra Madre, above Monterey, Nuevo Leon, *Pringle* 10188, June 5, 1906, TYPE, U. S. N. H. sheets Nos. 1097936 and 462232; U. of Minn. 152957; F. M. of N. Hist. 202140; Sierra Madre above Monterey, Nuevo Leon, *Pringle* 15610, May 25, 1908, type station, Deam Herb.

4. TILIA AMBIGUA Sargent, n. sp. in Sched. 1916.

Twigs very slender, slightly grayish-pubescent; winter-buds brownish or reddish, ovate, plump, pointed, about 3 mm. long, thinly pubescent; leaf-blades ovate, obovate, or oblanceolate, 5-10 cm. long, 4-6 cm. wide, sharply apiculate-serrate with low flat teeth, dark green and glabrous above, lighter and densely short grayish pubescent below, slightly oblique at the rounded base, long-acuminate at the apex; petioles very slender, 2-3 cm. long, slightly scabrous or nearly glabrous; bracts 7-10 cm. long, 1-2 cm. wide at apex, tapering to a long cuneate base, on stalks 5-10 mm. long, glabrous or glaucous on both sides, strongly and conspicuously reticulated, somewhat overtopping the cymes and flowers; peduncles 2-3 cm. long, grayish-pubescent; pedicels 5-10 mm. long; cymes small, few—(3-5) flowered; branches of the cymes, pedicels and fruit hoary-tomentose; fruit globose, about 6 mm. wide.

TYPE LOCALITY: Orizaba, Veracruz.

SPECIMENS EXAMINED: Orizaba, Veracruz, *Botteri* 63, no date given, marked "*Tilia ambigua* Sargent, ined.," U. S. N. H. 13523, TYPE: Orizaba, Veracruz, *Botteri* 63, about 1855-57, Arnold Arboretum; Orizaba, Veracruz, *Botteri* 63, about 1855-57, Field Museum of N. Hist. sheet No. 118976, the plant marked 1 on this sheet; N. Y. Bot. Garden, *Botteri* 40, limestone hills, Orizaba, Veracruz, 1856.

5. TILIA ROTUNDA n. sp.

Twigs rather stout, yellowish-hirsute; winter-buds brownish, ovate, plump, blunt, 3-4 mm. long; leaf-blades round or round-ovate, abruptly short-acuminate, 8-12 cm. long, 8-9 cm. wide, dark green and glabrous above, much lighter and finely stellate-pubescent below, minutely serrulate all around, the base deeply cordate or truncate-cordate; petioles 2-3 cm. long, tomentose at first, becoming glabrate; bracts short, 5-6 cm. long, 1-2 cm. wide at the apex, tapering to a cuneate base, on stalks 2-2.5 cm. long, overtopping the cymes and flowers; peduncles short, 2-2.5 cm. long, densely pubescent; pedicels very short, 4-6 mm. long; cymes very small, few—(5-12) flowered; branches of the cymes, pedicels and sepals densely pubescent; bractlets at the base of the pedicels oblong-linear, densely pubescent, twice as long as the pedicels and flowers.

TYPE LOCALITY: Morelia, Michoacan.

SPECIMENS EXAMINED: Vicinity of Morelia, Michoacan, *Bro. G. Arsene* 2664, April 11, 1909, TYPE, Arnold Arboretum; N. Y. Bot. Garden, two sheets, *cotypes*.

6. MILIA COAHUILANA n. sp.

Twigs rather stout, reddish or brownish, glabrous; winter-buds reddish or brownish, ovate, plump, pointed, 3-4 mm. long, pubescent at ends; leaf-blades orbicular or round-ovate, abruptly long-pointed, truncate or obliquely-cordate at the base, yellowish-green and glabrous above, paler and smooth below, except tufts or yellowish tomentum in the axils of the veins, coarsely serrate or dentate nearly all around; petioles slender, 3-4 cm. long, glabrous; bracts long, 8-12 cm. long, 1-2 cm. wide, slightly narrowed to a nearly sessile base, overtipping the cymes and flowers; peduncles 2-3 cm. long, slender, slightly scabrous; pedicels 5-8 mm. long; cymes medium-sized, few—(5-7) flowered; branches of the cymes and pedicels grayish-pubescent.

TYPE LOCALITY: Monclova, Coahuila.

SPECIMENS EXAMINED: Mountain m. Monclova, Coahuila, *Dr. E. Palmer* 118 U., February to October, 1880, TYPE,

Arnold Arboretum; Mountains called Caracol, 21 miles southeast of Monclova, Coahuila, *Dr. E. Palmer* 118 U., August 19 to 22, U. S. N. H. 1380873, is probably this species.

I have seen three sheets of Palmer's 118, and there are certainly two species under this number, one having the bracts very unequal at the base and long-stalked, the other two plants having bracts equal at the base and nearly sessile. Sargent referred all these sheets to *T. floridana*, but to my mind the one I hereby describe is distinct from that species.

7. TILIA NELSONI n. sp.

Twigs loosely brownish-tomentose, becoming nearly glabrous, dark brown or red; winter-buds ovate, plump, obtuse, at first tomentose, becoming blabrous, about 3 mm. long; leaf-blades ovate, ovate-oblong or round-ovate, 8-15 cm. long, 8-12 cm. wide, truncate, obliquely-truncate or subcordate at the base, tapering to a long acute point, the smaller ones subcordate, serrulate nearly all around with sharp apiculate teeth pointing forward, dark green and glabrous above, finely grayish stellate-pubescent below, the principal veins on the lower surface of the leaf more or less brownish-hirsute or pubescent; bracts large, 5-10 cm. long, 1-2 cm. wide, long-attenuate at the base, peduncled, rounded at the apex, much overtopping the cymes and flowers, or sometimes shorter, glabrous above, pubescent or soon glabrous below; peduncles slender, 3-5 cm. long, loosely pubescent, becoming glabrous; cymes medium-sized widely spreading, few—(3-8) flowered; branches of the cymes, pedicels and sepals finely tomentose, brownish or yellowish; flowers middle-sized, 6-7 mm. long; fruits about 6 mm. long, densely grayish-tomentose.

TYPE LOCALITY: Cañon at Omilteme, Guerrero, San Luis Potosi.

SPECIMENS EXAMINED: Cañon at Omilteme, Guerrero, San Luis Potosi, *E. W. Nelson* 7044, May 15, 1903, U. S. N. H. No. 399385, TYPE; N. Y. Bot. Garden, co-type.

8. TILIA LONGIPES n. sp.

Twigs very slender, grayish, finely tomentose; winter-buds small, 2-3 mm. long, brownish, ovate, plump, pointed, loosely pubescent; leaf-blades round-ovate, 10-15 cm. long, 6-10 cm. wide, dark green above, lighter and densely finely pubescent below, sharply serrate all around with long slender teeth, obliquely truncate at the base; petioles slender, 5-6 cm. long minutely grayish-pubescent; bracts 10-12 cm. long, 2.5 cm. wide above, tapering to a long cuneate base, on stalks 1-2 cm. long, about as long as the cymes and flowers, densely grayish stellate-tomentose below; peduncles very slender, 4-5 cm. long, minutely grayish-pubescent; pedicels very short, 4-5 mm. long; cymes small, compact, few—(5-10) flowered; bractlets at the base of the pedicels conspicuous, oblong-linear, densely pubescent, twice as long as the pedicels and flowers; branches of the cymes, pedicels and sepals finely and closely grayish-pubescent.

TYPE LOCALITY: Orizaba, Veracruz.

SPECIMENS EXAMINED: Orizaba, Veracruz, *Botteri* 63 pp., about 1855-57, Field Museum 118976, the plant marked 2 on this sheet, TYPE.

9. TILIA OCCIDENTALIS Rose, Contr. U. S. N. H. *8*: 4. 317. 1905.

T. mexicana Benth. Pl. Hartweg. 35. 1839, according to Engler, l. c. 125, and Sargent in TILIA, l. c. 434, not *T. Mexicana* Schlecht., Linnaea, 1837.

T. mexicana occidentalis (Rose) Engler, Monog. TILIA, 125. 1909.

Bentham's *T. mexicana* was collected near Angangueo, Michoacan, (not Anganguio as given by Sargent) by Hartweg, and may not be the same as *T. occidentalis*.

Michoacan, Engler, l. c. 126.

S. Andreia? *Hartweg* 276, Engler, l. c. 126.

Angangueo, Michoacan, Hartweg 276, Engler, l. c. 126.

Patzcuaro, Michoacan, *Pringle* Pl. Mexic. 4126, Engler, l. c. 126.

Twigs stout, brownish-tomentose, becoming glabrate; winter-buds ovate, plump, blunt, reddish or brownish, glabrous, about 3 m. long; leaf-blades round-ovate, obliquely truncate or truncate cordate at the base, 8-10 cm. long, 6-8 mm. wide, abruptly short-acuminate, dark green and glabrous above, more or less coarsely stellate-pubescent with brownish tomentum below when young, finally becoming nearly glabrous, the primary veins below shaggy brownish or yellowish, coarsely serrate; petioles 3-4 cm. long, stout, covered with brownish or yellowish spreading tomentum, or nearly glabrous when mature; bracts small, 5-12 cm. long, 1-3 cm. wide, rounded at the broad apex, subsessile or very short stalked, glabrous above, or sometimes stellate-pubescent, glabrous below, much shorter than the cymes and flowers; pedicels slender, 5-10 cm. long, loosely hirsute or pubescent, brownish or yellowish; cymes large, wide-spreading, many—(10-30) flowered; branches of the cymes, pedicels, sepals and fruits densely short-hirsute, brownish; flowers rather large, 7-8 mm. long.

TYPE LOCALITY: Patzcuaro, Michoacan.

SPECIMENS EXAMINED: Mountains about Patzcuaro, Michoacan, Pringle 4126, July 22, 1892, TYPE, presumably in the U. S. N. Herbarium, but no specimen seen from there; Field Museum 264023; Univ. of Minnesota 152877; Iowa State College 42443, and Arnold Arboretum; vicinity of La Parada, Oaxaca, *E. W. Nelson* 999, August 19, 1894, U. S. N. Herbarium 866456, labeled *T. Houghii*.

In the original publication of *T. occidentalis*, Rose includes Nelson's 6874, collected at base of Mount Tancitaro, Michoacan, in his new species, but this is certainly far from Pringle's 4126, and I am describing it as new.

10. TILIA HOUGHII Rose, Contr. U. S. N. Herb. *8*: 4. 318. 1905.

TYPE LOCALITY: Cuernavaca, Morelos.

T. mexicana Simk., l. c. according to Engler, l. c. 126, not *T. mexicana* Schlecht, 1837, but Engler had in mind a different species.

T. mexicana Houghii (Rose) Engler, Monog. TILIA 126, 1909, as to combination, but not as to specimens cited to support this combination, which belong to a different species.

Oaxaca, *Galeotti* 4158 and 4198, according to Engler l. c. 126, but no doubt a mistake on the part of Engler, as no specimens are known of this species from the State of Oaxaca.

Cuernavaca, Morelos, *Pringle*, Pl. Mexic. 10264, according to Engler, but Engler is in error as to this, as it is not *T. Houghii*, and Engler did not know the real *T. Houghii*, never having seen it.

"Leaves nearly orbicular, 10-15 cm. long by 8 to 12 cm. broad, abruptly short-acuminate, somewhat oblique at base with a broad shallow or moderately deep sinus, very pale and densely stellate-pubescent beneath, dark green and glabrous above, the margin sharply serrate, the winged peduncle subsessile, very broad, obtuse, not reaching the cyme, pedicels and buds densely stellate-pubescent, almost white" ex Rose.

"The large broad leaves which are much paler beneath and covered with a finer pubescence, distinguish this from *T. mexicana*" ex Rose. But this species is not to be compared to *T. mexicana* Schlecht, but it might be compared to *T. mexicana* Benth., which is *T. occidentalis* Rose. "Collected by J. N. Rose and Walter Hough in a mountain canyon above Cuernavaca, Morelos, May 27-30, 1899, No. 43.98," ex Rose.

"Leaves 6 to 16 cm. long, 4.5-12 cm. wide, abruptly short-acuminate, obliquely truncate to cordate at base, bright green and glabrous above, densely and persistently tomentulose beneath; bracts sessile or pedunculate; petals 6 to 7 mm. long; fruit about 7 mm. in diameter, densely tomentulose."

"Michoacan, Oaxaca, Hidalgo, Morelos and Veracruz" ex Standley. This description is evidently drawn from several specimens, as no specimens of *T. Houghii* are known from Michoacan, Oaxaca, Hidalgo or Veracruz, and it is probable that Standley regarded Pringle's 10264 the same as *T. Houghii*, and it is quite clear that Engler did.

Twigs yellowish-gray, densely tomentose-hirsute, rather stout; winter-buds brownish, ovate, plump, obtuse, pubescent,

about 3 mm. long; leaves very large, nearly orbicular, 11-12 cm. long, 8-12 cm. wide, abruptly short-acuminate, nearly symmetrical at the base or subcordate, dark green and glabrous above, very pale and densely short stellate-pubescent below with easily detached tomentum and tufts of brownish tomentum in the axils of the veins, sharply serrate all around with moderately small, sharp teeth; petioles short, stout, 2-2.5 cm. long, densely clothed with loose grayish or in age deciduous pubescence; bracts rather large, 8-10 cm. long, 1.5-2 cm. wide, nearly sessile, glabrous on both sides, strongly reticulated, but little longer than the cymes and flowers; peduncles slender, 3-4 cm. long, grayish-pubescent; pedicels stout, 4-6 mm. long; cymes rather large, many—(15-20) flowered; branches of the cymes, pedicels and sepals loosely yellowish-white, the buds just beginning to open.

11. TILIA PATZCUAROANA n. sp.

Twigs rather stout, densely fulvous-tomentose; winter-buds reddish or brownish, ovate, plum, blunt, about 4-5 mm. long; leaves round-ovate, abruptly long-acuminate, cordate at the base, scarcely unsymmetrical, 10-18 cm. long, 10-14 cm. wide, minutely serrulate all around, dark green and glabrous above, yellowish below with stellate-pubescence; petioles stout, 3-4 cm. long, densely pubescent with fulvous spreading pubescence; flowers and fruit not seen.

TYPE LOCALITY: Patzcuaro, Michoacan.

SPECIMENS EXAMINED: Hills of Patzcuaro, Michoacan, *Pringle* 3578, November 21, 1890, TYPE, Arnold Arboretum; vicinity of Morelia, Michoacan, *Bro. G. Arsene* 5355, December, 1910, Arnold Arboretum, I refer here with some doubt, but as it is only a leading shoot, no certainty can be placed on any determination.

12. TILIA SARGENTIANA n. sp.

T. Houghii Rose, Standley, and other Am. authors, in part.

T. Houghii Engler, Monog. TILIA, 126, 1909, not *T. Houghii* Rose, 1905, being misled by the name on the labels.

T. mexicana Simk. in Math. es termez. Koslem. *22*: 7. 315. 1888, according to Engler, l. c. 126, but evidently not the *T. Houghii* Rose, nor the present species, as no specimens are known of either except the type collections.

T. Houghii Schneider, according to Engler, l. c. 126, but Schneider was evidently misled by the name on the labels.

Twigs grayish or yellowish-tomentose, thick; winter-buds reddish or brownish, ovate, blunt, 3-5 mm. long: leaves round-ovate, oblong-ovate or deltoid-ovate, very oblique at the base, or sometimes truncate or rounded, abruptly pointed at the apex, 5-10 cm. long, 5-8 cm. wide, deep green and glabrous above, yellowish or brownish below with fine, close, stellate-tomentum, the principal veins on the under surface of the leaf not very conspicuous and more or less appressed-hirsute, reddish or brownish, minutely serrulate or denticulate all around with apiculate teeth; petioles short, stout, 2-2.5 cm. long, yellowish or brownish-tomentose like the midvein; bracts very small, 5-6 cm. long, 5-10 wide, tapering to a sessile base, narrowed at the apex to a blunt point, glabrous on both sides, somewhat overtopping the cymes and flowers; peduncles slender, 2-2.5 cm. long, yellowish or brownish-tomentose; pedicels stout, 10-15 mm. long; cymes very small, few—(2-6) flowered; branches of the cymes, pedicels, sepals and fruit yellowish-pubescent; both flowers and fruit on the twigs; fruit nearly globose, 5-6 mm. long.

Compared with *T. Houghii*, with which this has been confused, this has leaves scarcely one-half as long and of an entirely different shape, petioles much longer and as compared with the size of the leaf, very much longer, fewer-flowered cymes, pedicels more than twice as long, larger and plumper winter-buds, much smaller bracts, and a brownish appearance. It is with great pleasure that I associate Prof. Sargent's name with this handsome-appearing and distinct species of TILIA, of which he had already indicated as new on one of the labels.

TYPE LOCALITY: Cuernavaca, Morelos.

SPECIMENS EXAMINED: Wet mountain canyon above Cuernavaca, Morelos, *Pringle* 10264, July 30, 1906, U. S. N. Her-

barium 462281, TYPE; University of Minnesota Herbarium 152921; Field Museum of Natural History, 202193; Deam Herbarium.

13. TILIA ROSEANA n. sp.

T. cordata Rose, in Herb., not *T. cordata* Mill. 1759.

T. caroliniana vagans Engler, Monog. TILIA. 132. 1909.

Twigs brownish-red, or at first grayish-pubescent, slender, glabrous; winter-buds brownish-red, ovate, plump, pointed, about 3 mm. long; leaf-blades round-ovate, tapering to a long acute point, 5-12 cm. long, 5-8 cm. wide, dark green and glabrous above, grayish with fine, dense stellate-pubescence below, the principal veins on the under surface very prominent, yellowish, sharply serrulate all around, except at the bases, with low, broad, apiculate teeth pointing forward, the base of the leaf truncate or subcordate, the smaller ones deeply cordate; petioles long, 3-4.5 cm. long, very slender, glabrous, yellowish like the midveins; bracts small, 5-10 cm. long, long-tapering at the base, broader at the upper ends, glabrous above, minutely pubescent or glabrous below, on stalks about 6 mm. long, much shorter than the cymes and flowers or sometimes longer; peduncles very slender, 2.5-4 cm. long, minutely pubescent or glabrous; pedicels very short, 5-7 mm. long; cymes small, few—(5-7) flowered; flowers small, 4.5-5 mm. long; branches of the cymes, pedicels and sepals closely minutely tomentose.

TYPE LOCALITY: Honey Station, Hidalgo.

SPECIMENS EXAMINED: Wet bluffs of the barranca below Honey Station, Hidalgo, *Pringle* 10800, September 21, 1908, TYPE, Deam Herbarium: El Chico, State not given, *Ehrenberg*, date not given, N. Y. B. G. Herb.

14. TILIA PERTOMENTOSA n. sp.

Twigs stout, densely tomentose with coarse brownish hairs; winter-buds brownish-red, ovate, plump, obtuse, 3-4 mm. long, hairy at the ends; leaves ovate, broad-ovate or ovate-oblong, 7-12 cm. long, 5-9 cm. wide, dark green and

glabrous above, densely short-tomentose below with brownish hairs, nearly entire or minutely serrulate on the margins, obliquely truncate at the base, or the smaller ones subcordate or truncate-cordate; petioles rather long, 3-4 cm. long, stout, yellowish brown like the twigs; bracts large, 8-12 cm. long, 10-15 mm. wide, very unequal at the base, peduncled, rounded at the tip, glabrous above, loosely stellate-tomentose below or at length glabrate, much exceeding the cymes and flowers; peduncles stout, 2-3 cm. long, loosely tomentose, with brownish hairs, at length glabrous; pedicels very short, 3-5 mm. long; cymes very small, few—(3-7) flowered; branches of the cymes, pedicels and sepals brownish-tomentose.

TYPE LOCALITY: Mount Tancitaro, Michoacan.

SPECIMENS EXAMINED: North slope of Mount Tancitaro, Michoacan, *E. W. Nelson* 6874, February 23, 1903, U. S. N. H. 399225, TYPE.

15. TILIA ARSENEI n. sp.

Twigs rather stout, densely yellowish-tomentose; winter-buds brownish, ovate, plump, obtuse, densely pubescent, about 3 mm. long; leaves round-ovate, 10-15 cm. long, 7-10 cm. wide, truncate or subcordate at the base, dark green and glabrous above, grayish and densely stellate-pubescent below, obscurely serrulate all around or nearly entire; petioles very short, stout, 1-2.5 dm. long, densely yellowish-hirsute-tomentose; bracts very large, much exceeding the cymes and flowers, 10-18 cm. long, 2-2.5 cm. wide, finely and conspicuously reticulated, on stalks 8-12 mm. long, glabrous on both sides, the stalks and midribs densely pubescent; peduncles 3-4 cm. long, loosely pubescent; pedicels 5-10 mm. long; cymes small, congested, few—(5-10) flowered; branches of the cymes, pedicels and sepals densely yellowish-tomentose.

TYPE LOCALITY: Morelia, Michoacan.

SPECIMENS EXAMINED: Vicinity of Morelia, Michoacan, *Bro. G. Arsene* 2534, May 5, 1909, TYPE, Arnold Arboretum.

Book Review

ANTS, BEES AND WASPS, A RECORD OF OBSERVATIONS OF THE HABITS OF THE SOCIAL HYMENOPHERA. By Sir John Lubback. E. P. Dutton & Co., New York, 1929. 377 pages. $3.75.

This is a book for all entomologists, in fact, for all lovers of nature, for it can be read by the layman. The writer uses an easy, familiar style that has a peculiar charm. But for all its literary charm, the book is really a record of observations carried on according to the most rigorous scientific canons. And these observations were not mere chance observations, made at random. Lubbock kept an ant's nest under constant observation for more than seven years. He applied the same meticulous care to the study of bees and wasps. Though done nearly a century ago, Lubbock's work is still standard. The annotations by Dr. J. G. Myers are just what was wanted to bring the book up to date. There is a table of contents and a good index.

F. W.—

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FISH TREMATODES FROM THE LOWER TALLAHATCHIE RIVER

PARKE HARVEY SIMER

During the spring and summer of 1927 a study was made of the parasitic fauna of fish secured from the Tallahatchie river, Mississippi. Collections were made from February until June, and again during August and part of September. The present paper summarizes the results of the study of the trematodes of this collection, and a later paper will consider the other groups of parasites. Those species already satisfactorily described are considered here only from the standpoint of the degree of host infection in this locality. The author is greatly indebted to Dr. Henry B. Ward for his many helpful suggestions during the progress of the field work and throughout the course of this study.

GENUS ANALLOCREADIUM nov. gen.

Generic diagnosis: Distomes 2 to 4mm. long with ends equally rounded. Anterior sucker subterminal, ventral sucker circular, at one third the length of the trematode from the anterior end. Ratio of transverse diameter of oral to ventral sucker is as 2 to 3. Excretory pore median, terminal. Excretory vesicle extends to the posterior border of the posterior testis. Testes median, spheroid, slightly elongated in transverse diameter. Ovary dextral, at anterior margin of

the anterior testis. Laurer's canal and Mehlis' gland present. Seminal vesicle arises at posterior boundary of ventral sucker, is twice as long as wide, and is continued toward the anterior as a small tube which joins the uterus at the level of the center or anterior margin of the ventral sucker. The common tube from this point to the genital pore is an unspecialized cloacal invagination. Uterus short, confined to the area anterior to the testis. Eggs few in number, 90 to 110 by 60 to 70 u. Vitellaria extend from the level of the posterior margin of the ventral sucker to the posterior end, confluent behind testes.

In the intestine of *Aplodinotus grunniens*. Type and only species, *Anallocreadium armatum*. (MacCallum 1895)

ANALLOCREADIUM ARMATUM (MacCallum 1895)

From the intestine of *Aplodinotus grunniens, Polyodon spathula.*

Individuals of this species were collected from 26 of the 41 drums (*A. grunniens*) examined. Small hosts ranging from 1 to 2 pounds usually harbored several of these trematodes, while those weighing 10 pounds and over harbored few or none. Very few were secured from hosts examined before March 15, but as the season progressed, they were found in increasingly large numbers. A single specimen was collected from the spiral valve of a spoonbill (*P. spathula*) but all facts indicate that this was a case of accidental infection.

MacCallum (1895) described this trematode under the name of *D. isoporum var. armatum*, but recognized certain distinct differences between it and *D. isoporum* Looss. As was stated by Looss (1902) this trematode cannot be considered as a variety of any species of the subfamily Allocreadiinae Looss, or even a member of this subfamily. The lack of specialized cirrus sac prevents its inclusion in the subfamily Lepocreadiinae Odhner and the lack of oral papillae excludes it from the subfamily Stephanophialinae Nicoll. Inasmuch as the structure and connections of the

cirrus sac and the uterus present a condition not recognized in any of the established genera of the family Allocreadiidae Stoss., this species is made the type and at present the only member of the new genus Anallocreadium.

CREPIDOSTOMUM CORNUTUM (Osborn 1903)

(Figs. 4, 5, 6.)

From the intestine of *Micropterus salmoides*, *Chaenobryttus gulosus*, and Lepomis sp.

More than 250 individuals of this parasite were secured from the intestine of the single specimen of *M. salmoides* examined. Only 2 or 3 were secured from each of 14 specimens of *C. gulosus*, and 1 or 2 each from 7 of 17 specimens of Lepomis sp., mostly *Lepomis humilis*. The trematodes from *M. salmoides* were larger and in almost every case contained more eggs than those from the other host species. In a few cases, the uterus of these forms reached well past the anterior border of the posterior testis, but this condition was never found in parasites from the other hosts. Nicoll (1909), in his original diagnosis of the subfamily Stephanophialinae says, "Uterus confined between anterior testis and ventral sucker. Ova not numerous." Faust (1918) reviews the entire subfamily and supplements the diagnosis. All specimens in this study show entire agreement with Nicoll's diagnosis of the subfamily as amended by Faust with the exception that some possess an elongated uterus and increased number of eggs. In all other morphological features my specimens are in entire agreement with *C. cornutum* as described by Osborn (1903) and Faust (1918). It therefore seems advisable to modify the diagnosis of this subfamily to include forms in which the uterus extends to the level of the anterior margin of the posterior testis and the number of eggs approaches 150 to 200.

GENUS MICROCREADIUM nov. gen.

Generic diagnosis: Small distomes, usually less than 1mm. in length, with anterior end slightly truncated and posterior

end slightly pointed. Anterior sucker terminal, collar like. Prepharynx, pharynx and esophagus present. Intestinal ceca reach to near the posterior end. Ventral sucker close to anterior end, smaller than the anterior sucker. Testes at the center, lateral, at almost the same level. Ovary spherical, dextral, partly dorsal to the ventral sucker. Large spherical seminal vesicle, dorsal and anterior to ventral sucker. Cirrus wanting. Genital pore anterior to ventral sucker, in the midline. Laurer's canal and receptaculum seminis present. Uterus short, containing few eggs, 104 by 64u. Excretory vesicle extending almost to the testes. Vitellaria follicular, posterior to testes and distributed throughout posterior body region. This genus is to be classed under the family Allocreadiidae, but the absence of a cirrus pouch and oral papillae, and the position of the testes prevent its inclusion in any of the present recognized subfamilies of this group.

Type and only species, *Microcreadium parvum.*

MICROCREADIUM PARVUM nov. spec.

(Fig. 9)

From the intestine of *Aplodinotus grunniens.*

Specimens of this trematode were secured from 25 of the 41 hosts of this species examined. While the average number of parasites per host was about 250, more than 2,000 were taken from a single host. No activity was observed in any of the living specimens.

The average length of *M. parvum* is 0.66mm., and the average width is 0.31mm. The body is ovoid in shape and is provided with an abundance of small spines. The oral sucker is terminal, in the form of a low collar, and serves to cap the slightly truncated anterior end. The thin walled prepharynx is about 30 u long and is followed by a spherical pharynx having an average diameter of 40 u. The esophagus is about one half as long as the prepharynx. The ceca lie close to the lateral boundaries, midway between the two surfaces, and extend almost to the posterior end. The excretory

pore is posterior and median and opens into a large, almost cylindrical, excretory vesicle which extends forward in the midline almost to a level of the testes. The ventral sucker is spherical and is located at from one third to one fourth of the body length from the anterior end. The relation of its transverse diameter to that of the oral sucker is as the ratio of 7 to 10. The muscular development of the ventral sucker is so weak that some doubt exists as to the functional activity of this structure. The testes are spheroid or ovoid, lateral and close together, and lie near the center of the trematode. The spherical seminal vesicle lies dorsal to the ventral sucker, in the midline, and has a diameter of about 0.1mm. The small tubule from the anterior margin of this structure passes to the ventral surface and opens at the genital pore just anterior to the ventral sucker. While the proximal portion of this tubule is surrounded with a few large, deeply staining cells which constitute the prostate gland, no further modifications occur and both cirrus and ejaculatory duct are therefore considered to be lacking. The ovary is spherical, about the size of the seminal vesicle, and lies slightly dextral, near the posterior margin of the ventral sucker. The oviduct which arises at the posterior margin of the ovary connects first with the large receptaculum seminis, and then with the common yolk duct. The former structure is spherical, about the same size as the ovary, and lies dorsal to it. Laurer's canal is present, opening in the midline at the level of the testes. The uterus has no coils and contains only a few large eggs, the maximum dimensions of which are 104 by 64 u. The vitellaria are follicular and extend from about the level of the center of the testes to the posterior end. The follicles are small but numerous, and are densely packed at all levels posterior to the testes with the exception of the midline, where they are less numerous but not entire lacking.

CLINOSTOMUM MARGINATUM (Rudolphi 1819)

From the oral cavity and esophagus of *Polyodon spathula.*

Only three immature specimens of this distome were collected from examinations of 171 individuals of this host species. The presence of these parasites in the intestinal tract of this host is probably to be explained by the characteristic feeding habits of this fish. Infection of the spoonbill with *C. marginatum* was doubtless accidental and it is extremely doubtful if these immature forms would have developed into mature parasites. Instead, one might expect them to die and disintegrate as they passed into the region of the intestinal ceca and the spiral valve.

MACRODEROIDES SPINIFERUS Pearse 1924

(Fig. 15)

From the intestine of *Lepisosteus osseus*

10 of the 12 individuals of this host examined contained this species of trematode. The two individuals of this host which did not harbor the parasite were small, less than two feet in length. Hosts examined in March showed light infection, never more than 6 to a single host and these immature, but those examined in July and August often harbored as many as 15 or 20, all of which were mature.

Pearse (1924) established the genus Macroderoides and described as the type species *M. spiniferus,* from the intestine of *L. platostomus,* in Wisconsin. Through the courtesy of the U. S. National Museum the type of *M. spiniferus* was secured and studied. It was noted that certain discrepancies occur between the original description of this species and the type specimen. The location of the ventral sucker in the type specimen is at the posterior boundary of the anterior one fourth of the trematode and not at the posterior boundary of the anterior one seventh. In other specimens of this species the position of the ventral sucker was found to vary from near the center to the position noted in the type specimen. The measurements of the pharynx are 0.072 by 0.048mm., rather

than 0.012 by 0.88mm. as previously described. Finally, the testes are not always ellipsoidal, but may be spherical, and are not always equal in size. The ovary was originally described as a spherical organ, but in the type specimen its outline is slightly irregular. In the specimens collected in this study the ovary was distinctly 3 lobed, but in all other morphological details the parasites were identical with the type specimen of *M. spiniferus*.

GENUS ALLOGLOSSIDIUM nov. gen.

Generic diagnosis: Elongated Plagiorchiidae with the posterior half of the body tapering to a blunt posterior end, anterior about half equal in width throughout, with anterior end broadly rounded. Oral and ventral suckers about equal in diameter, the former oval, the latter circular and at the posterior margin of the anterior one fourth of the body. Prepharynx, pharynx and esophagus present. Ceca reach to near to the posterior end. Genital pore anterior to ventral sucker, slightly sinistral. Testes spheroid or ellipsoid, one behind the other. Cirrus sac contains a large, two-parted, recurved seminal vesicle and a short prostate and ductus ejaculatorius. Ovary median, at posterior end of anterior body third, slightly lobed. Uterus extends to posterior end of the body and is filled with small eggs. Receptaculum seminis and Laurer's canal present. Vitellaria follicular, lateral, from about the level of the pharynx to the level of the anterior testis.

Type and only species, *Alloglossidium kenti*.

The genus Alloglossidium shows resemblance to Haplometroides Odhner 1910 and Glossidium Looss 1899. A tabular comparison of these three genera follows:

TABLE 1.

	Haplometroides	Glossidium	Alloglossidium
1. Shape	Posterior end rounded	Posterior end narrow and truncated	Posterior end narrow and rounded
2. Esophagus	Long	Short	Short
3. Ceca	Not in posterior body third	Reach almost to posterior end	Reach almost to posterior end
4. Seminal vesicle	Short, narrow	Short, 2 parted	Long, 2 parted
5. Eggs	43 to 46 u by 21 to 23 u	34 by 20 u	24 by 12 u

ALLOGLOSSIDIUM KENTI nov. spec.

(Fig. 8)

From the intestines of *Ictalurus punctatus.*

5 specimens were secured from one of the 4 hosts of this species which were examined. This distome is elongated with the pointed, posterior half the most evident feature of body form. The cuticula of the anterior body third is covered with small spines but a few are evident elsewhere. The oral sucker is subterminal and slightly oval with an average length of 276 u and average width of 242 u. The prepharynx averages 80 u in length and is followed by a pharynx averaging 120 u in length and 144 in diameter. The esophagus is approximately the same length as the prepharynx. The ventral sucker is situated a little more than one-fourth the length of the trematode from the anterior end, is circular, and has an average diameter of 210 u. The relation of the transverse diameter of the ventral sucker to that of the oral sucker is as the ratio of 3 to 3½. The excretory pore is terminal and median,and opens into the excretory vesicle, which at its distal end occupies a median position but gradually rises nearer the dorsal surface and extends to the level of the ovary. The testes are ellipsoidal and almost touch, the anterior one being slightly sinistral and near the center of the trematode, the posterior one median or slightly dextral and at about

the midpoint between the ventral sucker and the posterior end. They may be about equal with an average diameter of 350 u, or the posterior one may be elongated to twice that size. The two-parted seminal vesicle arises about midway from the anterior testes to the anterior margin of the ventral sucker. It is quite thin walled but well distended with sperms, having a maximum diameter of from 105 to 138 u. The vesicle extends to a point slightly anterior to the ventral sucker, then curves posterior and ventral and opens into the genital atrium which lies at the anterior border of the ventral sucker. The prostate and ejaculatory duct are limited to the recurved portion of this tube. The ovoid ovary has an average diameter of 250 u. It lies in the midline at the level of the origin of the seminal vesicle. The oviduct arises on the ventral surface at the center of the ovary and passes ventrally to the ootype. The receptaculum seminis is small. Laurer's canal is present. The uterus extends to the posterior end but on its return narrows at the distal end, becomes thick walled, and opens into the genital atrium. The vitellaria are follicular, but the follicles are quite large. They extend from the level of the esophagus to the middle of the anterior testis. The eggs are numerous and measure 24 by 12 u.

GENUS TRIGANODISTOMUM nov. gen.

Generic diagnosis: Small, transparent Plagiorchiidae with triangular body form. Suckers not well developed, anterior one subterminal, ventral one at or near center at apex of triangular body. Prepharynx, pharynx, and long esophagus present. Ceca reach almost to posterior end. Testes 2, globular, linear, in posterior body region. Cirrus sac crescentric, consisting of a short seminal vesicle, long prostrate, and protrusable cirrus. Genital pore at anterior border of ventral sucker, sinistral. Ovary of 3 distinct lobes, at anterior border of anterior testes. No receptaculum seminis. Uterus well filled with small eggs and extending to posterior end of

body. Vitellaria of small follicles, lateral, from the level of the ventral sucker to the level of the posterior testis.

Type and only species: *Triganodistomum translucens.*

The genus Triganodistomum shows resemblance to Plagiorchis Lühe 1901 and Lepoderma Looss 1899, as the following table indicates:

TABLE 2.

	Plagiorchis	Lepoderma	Triganodistomum
1. Body shape	Elongated. Oval in cross section	Elongated with oval to circular cross section	Distinctly triangular in lateral view. Circular in cross section
2. Ceca	Do not reach posterior end	Reach almost to posterior end	Reach almost to posterior end
3. Cirrus sac	Short	Long and slender	Long. Reaches to ovary
4. Seminal Vesicle	Large, not coiled	Small, coiled	Small, not coiled
5. Ovary	Not lobed	Not lobed	3 spherical lobes

TRIGANODISTOMUM TRANSLUCENS nov. spec.

(Figs. 1, 2, 3)

From the intestine of *Ictiobus bubalus.*

15 specimens were secured from the single individual of the genus Ictiobus in which specific determination was made. No specimens were secured from the other 48 individuals of this genus examined. This distome was characterized in life by its small size, transparency, and lack of movement. The body form is distinctly triangular in lateral view, with an average length of 1.0mm. The anterior sucker is almost terminal with the average diameter of 110 u. The muscle wall of the dorsal and lateral surfaces is much thicker than that of the ventral surface. The funnel shaped oral cavity opens into a short prepharynx. The pharynx is ovoid in shape and is followed by the esophagus which averages almost 100 u in length. The walls of the ceca are quite thin and appear to

have almost no muscular specialization. The ventral sucker is located at the apex of the triangular body and protrudes beyond the ventral surface. Its average diameter is 210 u, and its muscular walls are quite thick. The position of the ventral sucker varies from near the midpoint of the trematode to some distance anterior to the midpoint. The testes are median, the anterior one being spheroid and often slightly sinistral and lying about midway between the ventral sucker and the posterior end. The posterior testes is slightly dextral and it is usually larger and more elongated than the anterior one which it almost touches. The crescentric cirrus sac arises a short distance anterior to the anterior testes and is composed of a proximal thin walled seminal vesicle, and a distal thick walled portion constituting the prostate and protrusable cirrus. The total length of cirrus sac and cirrus varies from 170 to 200 u. The ovary is composed of 3 spherical lobes, each with a diameter of 70 u, and lies dorsal and slightly anterior to the anterior testes. A small group of cells constitutes the Mehlis' gland, but no receptaculum seminis is evident. The uterus consists of a loop which passes entirely to the posterior end and then returns to open into the genital atrium. The eggs are numerous and measure 19 to 24 u by 12 to 14 u. The vitellaria are composed of lateral follicles from the level of the center of the ventral sucker to the center of the posterior testis.

GENUS ALLOPLAGIORCHIS nov. gen.

Generic diagnosis: Small Plagiorchiidae with ends broadly rounded and oval to circular in cross section. Suckers large, circular, anterior about two thirds the diameter of the ventral sucker. Prepharynx, pharynx and esophagus present. Ceca reach almost to posterior end. Testes median, globular or slightly lobed, one diagonal behind the other. Cirrus sac short, crescentric, of almost equal diameter throughout, and extending from the anterior border of the anterior testis to genital pore at the left border and slightly above the level of the midpoint of the ventral sucker. Seminal vesicle short,

including not more than one third of the entire cirrus sac. Cirrus protrusable. Ovary of 3 shallow lobes, dextral, dorsal to the anterior testis. Laurer's canal present. Receptaculum seminis lacking. Uterine coils extend to the posterior end. Eggs numerous and small. Vitellaria follicular, lateral, mostly in posterior body third.

Type and only species, *Alloplagiorchis garricki.*

The morphological features of the genus Alloplagiorchis show similiarities to Plagiorchis Lühe 1901 and Haplometra Looss 1899, as indicated in the following table.

TABLE 3.

	Plagiorchis	Haplometra	Alloplagiorchis
1. Body form	Elongated. Slightly pointed at each end	Elongated. Ends equally rounded.	Short. Ends rounded
2. Suckers	Oral large. Ventral smaller	About equal. Near one another	Ventral larger. Near center of body
3. Genital pore	Anterior to acetabulum. Median to slightly sinistral	Anterior to the acetabulum	Sinistral at level of center of acetabulum
4. Eggs	35 to 40 u by 18 to 20 u	40 by 22 u	14 to 20 u by 10 to 12 u
5. Host	Amphibia, reptiles, and birds	Lungs of Amphibia	Intestine of fresh water fish

ALLOPLAGIORCHIS GARRICKI nov. spec.
(Fig. 7)

From the intestine of *Carpiodes difformis ?*

3 specimens of this distome were collected from the single host of this species examined. In life they were quite active and distinctly cylindrical or flask shaped. The average length was 0.65mm. and average width 0.31mm. The oral sucker is circular with a transverse diameter of from 140 to 170 u. The pharynx lies partly dorsal to the oral sucker and is approximately half as large in transverse diameter. The esophagus is slightly curved and the ceca reach to within 0.17 mm. of

the posterior end. The ventral sucker is proportionately quite large, ranging from 200 to 270 u in transverse diameter, and is located at the center of the trematode. The testes are irregular or in some cases apparently rectangular in outline and are situated close together near the posterior end, in about the median line. The crescentric cirrus sac arises at the anterior border of the anterior testes, in the midline. A spherical, thin walled, seminal vesicle is followed by a thick walled structure comprising the prostate and protrusable cirrus. Toward the anterior the cirrus sac curves to the left and opens into the genital atrium at the left margin of the ventral sucker at about the level of the midpoint of this organ. Throughout its entire length the diameter of the cirrus sac remains practically constant. The ovary is exceptionally large and lies posterior to the ventral sucker and dorsal to the anterior testes, slightly dextral. It consists of a median and 2 smaller lateral lobes. No receptaculum seminis is present. The uterine branches lie anterior, lateral and posterior to the testes, but do not pass between them. The numerous eggs average 11 by 16 u. The vitellaria consists of large, angular follicles and extend laterally from slightly below the level of the genital pore to the level of the midpoint of the posterior testis.

LISSORCHIS FAIRPORTI Magath 1917

From the intestine of Ictiobus sp.

Of the 49 buffalo fish examined, 22 harbored this distome. The average number of parasites per host was 4, but a maximum of 25 was secured from one host. In addition to the description of this form, Magath (1917) contributed important facts concerning its life history, based on the experiments with infected fish in experimental ponds at Fairport, Iowa. He states that the absence of this parasite in fish taken from the Mississippi river at Fairport is probably due to the absence of the correct intermediate host. It is evident that a suitable intermediate host is present in the Tallahatchie river,

for here immature distomes were collected as early as February 18, 1927, and mature ones on March 28 of the same season.

HALIPEGUS PERPLEXUS nov. spec.

(Figs. 10, 11, 12, 13, 14)

From the intestinal tract of *Polyodon spathula.*

2 immature specimens were secured from one spoonbill and a third was taken from another host of the same species. The location of these distomes in the intestinal tract varied, one being found in the esophagus, one in the stomach, and the other in the pyloric ceca. The specimens varied from 1.37 to 1.57mm. in length and from 0.59 to 0.66mm. in width. The body is cylindrical in cross section with the largest diameter in the region of the ventral sucker. The ends are broadly rounded. The oral sucker is subterminal and provided with well developed muscular walls. A prepharynx is lacking. The pharynx lies dorsal to the oral sucker and is almost spherical, with a diameter of about 100 u. A short esophagus leads into two greatly distended ceca which reach to the posterior end of the trematode. The size and heavy musculature of the ventral sucker is a striking characteristic of this form. It is situated near the center of the body, and has a transverse diameter approximately twice that of the oral sucker. The relation of the width of the sucker to the width of the trematode is as the ratio of 6.5 to 7.5, while the ratio of the thickness of the two is as 3.5 to 5. The testes are lateral, approximately equal in size, and lie posterior to the ventral sucker. The vasa efferentia unite at the anterior border of the ventral sucker to form the small vas deferens which passes in the midline almost to the level of the pharynx, then enlarges to form the seminal vesicle, and opens through a poorly developed ejaculatory duct into the ductus hermaphroditicus. This duct leads to the genital pore, situated in the midline at the level of the posterior border of the pharynx. The ovary is spherical with an average diameter of 80 u and lies posterior to the testes, in the midline. A spherical Mehlis' gland lies

close to it. The vitellaria are lateral and globular, the right one ovoid and entire, the left one two-lobed. They are located about half way between the testes and the posterior end, at about the same level. A receptaculum seminis is present. The uterus passes anterior in the midline and unites with the ejaculatory duct to form the ductus hermaphroditicus. (Fig. 14) No eggs were present. The excretory system is a specialized Y shaped system in which the two anterior branches unite anterior to the oral sucker.

The only species of the genus Halipegus to be recorded previously from the North American continent is *Halipegus occidualis* Stafford 1905. My specimens differ from this species in the position of the testes, the form and position of the vitellaria, and the type of the host. The occurrence of *H. perplexus* in such small numbers in the intestinal tract of *P. spathula* is probably a case of accidental parasitism and it is likely that this species, as is true of the other species of this genus, is normally a parasite of amphibians.

COTYLASPIS COKERI Barker and Parsons 1914.

From the esophagus of *Polyodon spathula.*

A single specimen of this trematode was secured from a spoonbill. When collected, the parasite was light yellow in color and entirely motionless. In these two respects this trematode differs from the specimens of *Cotylaspis cokeri* described by Barker and Parson (1914) and Stunkard (1917), but in all details of morphology there was exact correspondence. The occurrence of this trematode, normally a parasite of turtles, in the intestinal tract of *Polyodon spathula* is doubtless to be explained by the feeding habits of this host, and the form should be considered as an additional case of accidental parasitism.

COTYLOGASTER OCCIDENTALIS Nickerson 1900.

From the intestine of *Aplodinotus grunniens.*

Of the 41 specimens of this host examined, only 2 harbored this parasite, the average infection being 6 per host. The

only differences noted between these trematodes and Nickerson's (1902) description of the species are that in the Mississippi form the ovary is at the midpoint or in the posterior half of the body, and its position is median, sometimes even ventral, while Nickerson describes the ovary as being in the anterior half and dorsal. The testes in my specimens are somewhat more spherical than Nickerson indicates.

MICROCOTYLE SPINICIRRUS Mac Callum 1918.

From the gills of *Aplodinotus grunniens*.

Specimens of this trematode were found in over half of the drums examined in the gill region. The morphology of the form has been discussed by Mac Callum (1918), but certain points should be noted wherein my specimens differ from the description of the species as it now stands. These points of difference are noted in the following comparative chart.

	Mac Callum's specimens	My specimens
Number of genital hooks,	54	66 to 75
Length of genital hooks,	5 u	40 u
Diameter of circle of hooks,	20 u	138 u
Number of posterior suckers,	80 to 90	130 to 180
Branching of esophagus,	Anterior to genital pore	Posterior to genital pore

PHYLLODISTOMUM FAUSTI Pearse 1924

From the intestine of *Aplodinotus grunniens*.

Of the 33 drums examined during the spring and summer of 1297 only 1 harbored this parasite. During the spring of 1928, 20 additional drums were examined and 2 of them were found to contain 2 each of this species of trematode. In every case the parasite was in the distal portion of the intestine very near the cloaca.

A study of my specimens indicates that they conform quite closely with the specific description by Pearse (1924). It was noted, however, that much variation may exist in the appearance and position of the ovary and testes. In some cases the right testes is anterior and the left one almost median, both deeply incised while in the other cases the reverse position prevails and the organs are almost entire. Likewise, the ovary may be dextral or sinistral and either entire or lobed. In all other particulars the trematodes from Mississippi are identical with the description given by Pearse for the Wisconsin members of this species.

DIPLOBOTHRIUM HAMULATUM nov. spec.
(Figs. 16, 17, 18, 19)

From the gills of *Polyodon spathula.*

Trematodes of this species were found on the gills of all spoonbills examined. The minimum number found on any host was 2, the maximum 200, and the average about 50. These forms are elongated, from 1.22 to 8.44mm. in length, and possess two small, incomplete, anterior suckers in addition to the well developed posterior organ of attachment. This specialized organ consists of 6 lateral, non-stalked, non-ciliated suckers, each provided with a hook, and a median, terminal sucker provided with four hooks. 4 dorsal eye spots are present. The oral cavity lies in the midline, slightly ventral and near the anterior end, but it has no connections with the anterior suckers. This cavity opens into a median, spherical pharynx which connects with a long esophagus reaching from one fifth to one sixth the length of the trematode before it joins the lateral ceca. The ceca extends almost the posterior margin of the vitellaria area, then converge to form a median tube which extends into the posterior organ of attachment and ends blindly. Both esophagus and ceca are provided with simple and branched lateral diverticula. The testes lie in two layers in the central body third, between the lateral bands of vitellaria. They number about 150 and are

generally spheroid with an average diameter of 35 u. The sperms from the testes pass into a six lobed collecting vesicle, which lies immediately posterior to the median seminal vesicle. This organ is flask shaped, provided with a very heavy wall muscles, and varies from 160 to 208 u in length and from 192 to 238 u in transverse diameter. At the anterior end the seminal vesicle narrows to a small tube which completes a loop and leads to the cirrus. This organ is elongated and ovoid and has an average length of 296 u and an average maximum diameter of 112 u. The cirrus is provided with thick muscular walls of both longitudinal and circular fibers and opens into the genital atrium in the midline just posterior to the pharynx. The distal end of the cirrus is provided with a variable number of small genital spines. The ovary is a convoluted, tubular structure which lies anterior to the median band of testes. The oviduct opens into the pear shaped receptaculum seminis which has an average length of 144 u and an average diameter of 48 u and distally passes dorsal and after a series of short coils returns to the ventral surface where it joins with the genito-intestinal canal a short distance in front of the anterior margin of the ovary. Just anterior to the junction of the oviduct and the genito-intestinal canal, the common tube thus formed branches, the larger part being the common vagina and yolk duct, and the smaller one being the oviduct. This later vessel passes to the dorsal surface and becomes slightly enlarged to form a modified Mehlis' gland. From here the uterus becomes much enlarged and tightly coiled and passes in the midline to the genital atrium. The vaginae are paired, slightly lateral, and open on the dorsal surface at the level of the posterior margin of the seminal vesicle. Each vagina is short and soon unites with the lateral yolk duct and the common lateral tubes this formed pass toward the midline and unite to form the common yolk duct and vagina previously mentioned. The vitellaria bands are lateral and extend from the level of the vaginae almost to the posterior organ of attachment. The

yolk cells are arranged in dorsal and ventral layers. In living specimens they impart a dark color to the sides of the trematode while the median band of the testes and ovary is distinctly light. The eggs do not occur in the uterus in great numbers, the maximum being 6 in the forms examined. They are spheroid to ovoid with an average diameter of 80 u, although an elongated egg may have a length twice that diameter.

Diplobothrium hamulatum is the second species of the genus to be described. Leuchart (1842) established the genus and described the type species from the gills of the European sturgeon, but this description is quite inaccurate and incomplete due to an incorrect interpretation of the proper orientation of the specimen. No European material is available for restudy, but from Leuchart's description it is evident that *D. hamulatum* differs from *D. armatum* in the possession of 4 instead of 2 posterior spines, and in having non-stalked, non-ciliated lateral suckers rather than those of the stalked, ciliated type. Stafford (1904) reported *D. armatum* from the gills of *A. rubicundus* in Canada, and this constitutes the only record of this parasite from the American continent. While none of Stafford's material was available for study, through the kindness of Dr. G. R. LaRue several specimens of an unidentified species of gill trematode from the gills of a sturgeon at Black Lake, Michigan were secured and studied, and all proved to be identical with the spoonbill material, although somewhat larger. While not conclusive, these findings cast some doubt on the occurrence of both species of this genus in this continent.

It is worthy of more than passing interest that these two fish, the sturgeon and spoonbill, having as they do so many characteristics which indicate phylogenetic antiquity, should harbor parasites of this type. It is commonly supposed that ectoparasitic, monogenetic parasites are among the oldest of parasites and from them have arisen the endoparasitic forms. The occurrence in such large numbers of parasites of this

type on the gills of these two hosts, while not conclusive in itself, certainly suggests that the supposition is substantially correct.

SUMMARY

The trematodes of the parasitic fauna of 11 species of fish hosts from the Tallahatchie river, Mississippi, have been studied. Of the 15 species of trematodes considered, 9 have been previously described. They are as follows:

Anallocreadium armatum (Mac Callum 1895)
Clinostomum marginatum (Rudolphi 1819)
Cotylaspis cokeri Barker and Parson 1914
Phyllodistomum fausti Pearse 1924
Cotylogaster occidentalis Nickerson 1900
Microcotyle spinicirrus Mac Callum 1918
Crepidostomum cornutum (Osborn 1903)
Macroderoides spiniferus Pearse 1924
Lissorchis fairporti Magath 1917

The genus Anallocreadium is established to contain the trematode originally described as *Distomum isoporum var. armatum* Mac Callum.

Four of the trematodes collected are described as new species, and each is made the type of a new genus. These are:

Microcreadium parvum nov. gen., nov. spec.
Triganodistomum translucens nov. gen., nov. spec.
Alloglossidium kenti nov. gen., nov spec.
Alloplagiorchis garricki nov. gen., nov. spec.

The species, *Halipegus perplexus* nov. spec., and *Diplobothrium hamulatum* nov. spec., are described and placed in previously established genera.

References Cited

Barker, F. D., and Parsons, S. 1914.—A new Aspidobothrid trematode from Lesseur's Terrapin, Trans. Am. Micro. Soc., 33:261—262.

Faust, E. C. 1918.—Studies on American Stephanophialinae. Trans. Am. Micro. Soc., 37:183—198; 2 pl.

Leuckhart, F. S. 1842.—Zoologische Bruchstucke III Helminthologische Beitrage. Freib. 1842. 60 pp; 2 taf.

Mac Callum, G. A. 1918.—Notes on the genus Telorchis and other trematodes. Zoopath., 1:81; Figs. 37—51.

Mac Callum, W. G. 1895.—On the anatomy of two distome parasites of fresh-water fish. Vet. Mag., vol. 2, No., 7, pp. 1—12; 8 figs.

Magath, T. B. 1917.—The morphology and life history of a new trematode parasite, *Lissorchis fairporti* nov. gen. et nov. spec. Jour. Parasit. 4:58—69; 2 pl.

Nickerson, W. S. 1902.—Cotylogaster occidentalis n. sp. and a revision of the family Aspidobothridae. Zool. Jahrb. Syst., 15:597—624; 2 taf.

Nicoll, William. 1909.—Studies on the structure and classification of the digenetic trematodes. Quart. Jour. Micro. Sci., 53: 391—487; pl. 9—10.

Osborn, H. L. 1903—*Bundera cornuta* sp. nov., a new parasite from the Crayfish and certain fishes of Lake Chautauqua, N. Y. Biol. Bull., 5:63—73; 7 figs.

Pearse, A. S. 1924.—Observations on Parasitic worms from Wisconsin fishes. Trans. Wis. Acad. Sci. Arts and Letters. 21:147—160.

Stafford, J. 1904.—Trematodes from Canadian fishes. Zool. Anz., 27: 481—495. 1905.—Trematodes from Canadian vertebrates. Zool. Anz., 28:681—694.

Stunkard, H. W. 1917.—Studies on North American Polystomidae, Aspidogastridae, and Paramphistomidae. Ill. Biol. Monogr., 3:285-394, 11 pl.

EXPLANATION OF PLATES

All figures were drawn with the aid of the camera lucida with the exception of figures 12 and 14. The projected scale is equal to 0.1mm. unless otherwise indicated in the explanation of figures. The following abbreviations are used:

cs	cirrus sac	sr	seminal receptacle
eg	egg	sv	seminal vesicle
ej	ejaculatory duct	t	testis
et	excretory tubule	u	uterus
gi	genito-intestinal canal	v	vagina
gp	genital pore	ve	vas efferens
i	intestine	vt	vitellaria
p	pharynx	yd	yolk duct

EXPLANATION OF PLATE I.

Fig. 1.—*Triganodistomum translucens.* Lateral view.

Fig. 2.—*Triganodistomum translucens.* Sagittal section through pharynx, esophagus, and one lobe of the ovary.

Fig. 3.—*Triganodistomum translucens.* Ventral view.

Fig. 4.—*Crepidostomum cornutum,* from *Micropterus salmoides.* Ventral view. Scale equals 0.3mm.

Fig. 5.—*Crepidostomum cornutum,* from Lepomis sp. Dorsal view. Scale equals 0.3mm.

Fig. 6.—*Crepidostomum cornutum,* from *M. salmoides.* Dorsal view. Scale equals 0.3mm.

EXPLANATION OF PLATE II.

Fig. 7.—*Alloplagiorchis garricki.* Dorsal view. Scale equals 0.2mm.

Fig. 9.—*Microcreadium parvum.* Ventral view. Scale equals 0.3mm.

Fig. 10.—*Halipegus perplexus.* Transverse section through the ventral sucker, intestinal ceca, uterus, vasa efferentia, and excretory tubules.

Fig. 11.—*Halipegus perplexus.* Transverse section through the oral sucker, pharynx, intestinal ceca, and excretory tubules.

Fig. 12.—*Halipegus perplexus.* Ventral view. Scale equals 0.5mm.

Fig. 13.—*Halipegus perplexus.* Dorsal view, excretory tubules omitted. Scale equals 0.5mm.

Fig. 14.—*Halipegus perplexus.* Drawing of a model showing the connection of the uterus and ejaculatory duct.

EXPLANATION OF PLATE III.

Fig. 15.—*Macroderoides spiniferus.* Ventral view. Scale equals 0.5mm.

Fig. 16.—*Diplobothrium hamulatum.* Ventral view. Scale equals 0.2mm.

Fig. 17.—*Diplobothrium hamulatum.* Sagittal section through the dorsal ganglion, pharynx, genital pore, and seminal vesicle.

Fig. 18.—*Diplobothrium hamulatum.* Diagrammatic drawing of anterior end showing female reproductive system and main trunks of the nervous system, with eyespots.

Fig. 19.—*Diplobothrium hamulatum.* Ventral view of the posterior sucker.

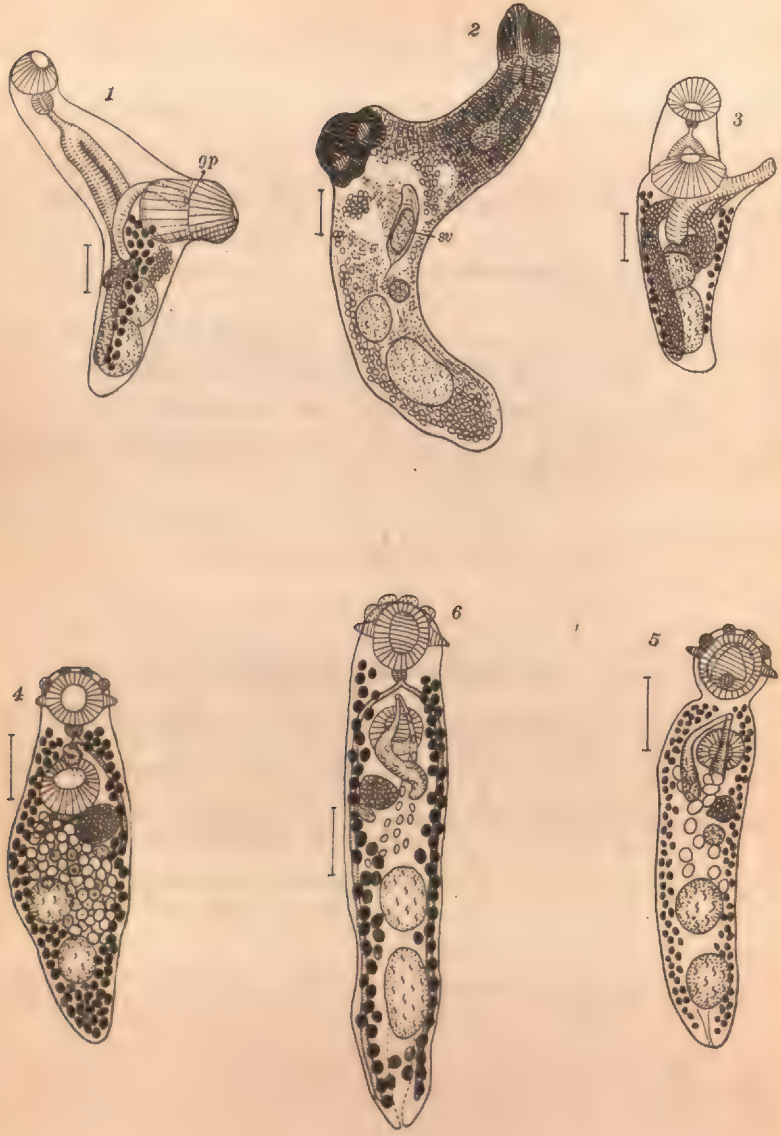
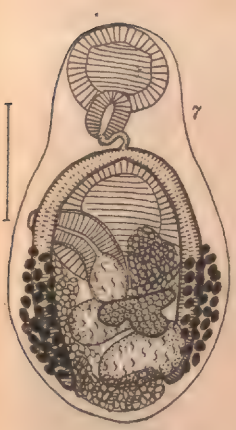
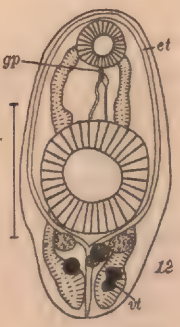
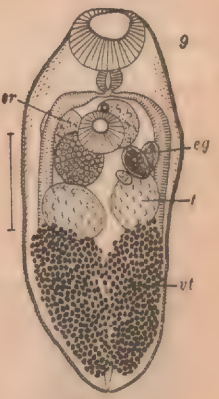
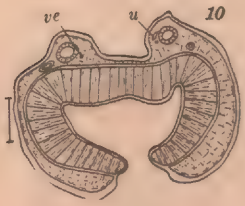


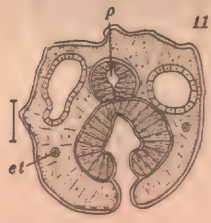
PLATE I.

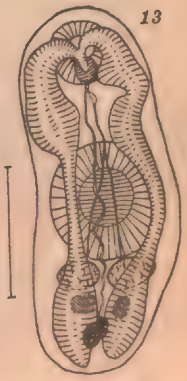












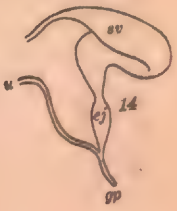
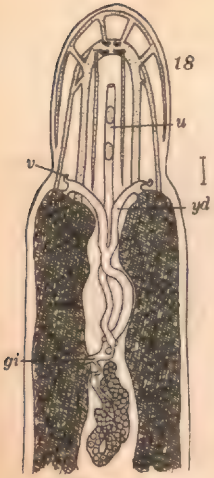
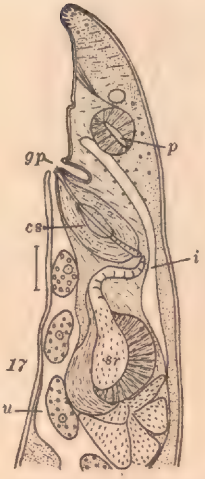
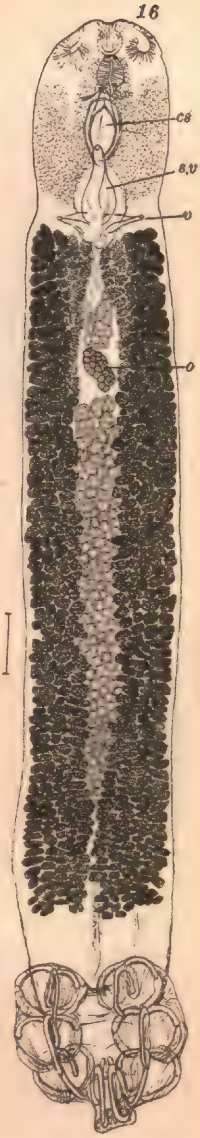


PLATE II.







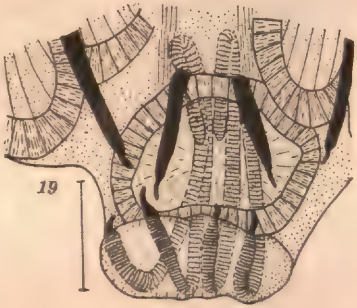


PLATE III.

A LIST OF PLANTS GROWING UNDER CULTIVATION IN THE VICINITY OF COLD SPRING HARBOR, NEW YORK

Biol. Monogr., 3:285—394, 11 pl.

N. M. and C. R. GRIER.

(*Continued from March issue.*)

IV.

A PARTIAL LIST OF LONG ISLAND ESTATES WITH A DESCRIPTIVE BIBLIOGRAPHY. * * *

Owing to the kindness of Miss Mildred A. Morse, Assistant in Fine Arts at Dartmouth College, and Mrs. J. M. Stetson (Sarah Louise Pattee) of Urbana, Illinois, we are able to give with this catalogue a partial list of Long Island estates together with references to articles describing a large number of them. The name of the landscape architect where known is indicated in parentheses after the name of the owner of the estate. It is believed that this additional data will make the list more valuable to students of landscape architecture, and those interested for any reason in the cultivated plants of Long Island.

BELLPORT

Mott, J. B.
House and Garden 7:121

BROOKVILLE

Flagg, Mrs. Benson.
Mitchell, S. Z. (Olmsted)
House and Garden 49:112, 113 *.

CLAYTON

Frick, Childs.

COLD SPRING HARBOR

DeForest, H. W. (Olmsted)

House Beautiful 25:56 *x; 52:206 *; 56: 328 *.

Garden Magazine and Home Builder 35:108 *.

DeForest Memorial Cemetery.

Jennings, Walter. (Olmsted)

Country Life 33:45 *x; 35:26 *; 42:52 *.

Kahn, Otto.

Architectural Record, 54: 22—24, 33, 34 *; 46:99—114.

Country Life 20:39:50.

EASTHAMPTON (11, 12)

Cummings, S. S.

Garden Magazine and Home Builder 37:242 *.

(Jap. iris garden)

Curtis, G. W.

Garden Magazine and Home Builder 31:352 *.

---

* Illustrations only.

x Descriptive matter only.

*x Both.

11 Shelton, Louise. Beautiful Gardens in America. Rev. Ed. New York, C. Scribners Sons 1924. 560 P. "Long Island" p. 199-270. One page of text, the others being illustrations of gardens and homes.

12 DeKay, Charles. Summer Homes at East Hampton, L. I. Architectural Record 13:19-33, 1903.

*** Of general interest are the following references:

Some typical Long Island gardens by O. H. Foster, Touchstone 6:361-9.

Great Gardens of America, Touchstone 2:612-19.

Long Island Homes, American Homes and Gardens 8:220-224.

Country Homes on Long Island, Outing 37:340-44.

13 Elwood, Philip, Jr. American Landscape Architecture. Architectural Book Publishing Co., 31 E. 12th St., New York.

Herter, Albert.
Country Life 29: 19—21 *x; 32:36, 37 *.
Hill, Mrs. R. C. (Dean)
Garden Magazine and Home Builder 33:311 *; 38:8 *.
Hollister, Frederick.
House Beautiful 57:131 * (Lawn, Hedge, and vines on House)
Leonard, Stephen. (Lowrie)
Architectural Record 49:338 *.
Country Life 43:50 *.
Pruyn, Miss Mary. (Shipman)
House Beautiful 55:236, 253, 254 *.
Woodhouse, Mrs. Lorenzo.
Beautiful Gardens in American Pl. 67 *. (11)
Country Life 32:60 *x. * *

GARDEN CITY

Doubleday Page and Company. The experimental gardens of "The Garden Magazine and Home Builder" 41:479. Article on "The Case of Fall Planting" 33:194. Evergreens.
Garden Magazine and Home Builder 38:74 *; 40:291 *

GLEN COVE

Aldred, J. E. (Olmsted)
Ayer, James C.
House Beautiful 58: 617 *.
Hine, F. L. (Olmsted)
Country Life 34:46 *; 36:40 *.
De La Mere (Pembroken) Japanese Garden.
Hine, F. L. (Olmstead)
Architectural Record 44:2—20 *x.
Kenyon, Mrs. Clarence, Jr. (Lardel)
Architectural Record 52: 49 *x.
Luckenbach Estate
Martin, Henry C.
Architectural Record 52:46 *x; 55:331, 365 *.
House Beautiful 52:197 *x; 56:221—224 *.

Milliau, Louis G. De.
Country Life 46:65 *.

Pratt, George D. (Greenleaf)
Architectural Record 49:429 *; 35:558—73.
Country Life 26:34—40 *x; 29:21 *x; 33—47 *x; 34:45 *; 34:42 *; 38:45 *; 39:53 *; 42:74 *; 45:43 *x; 46:59 *.
Garden Magazine and Home Builder 33:193 (Evergreens) *.
House and Garden 42:43; 39:31, 51.

Pratt, Mrs. Harold I.
Country Life 29:21, 22 *x; 32:61 *; 43:50 *x; 45:43 *x.
House Beautiful 46:9 *; 53:361 *.

Pratt, Herbert L. (Greenleaf)
American Country Houses of Today P. 219—225 *x.
Architectural Record 49:428 *.
Landscape Architecture 13:38—39.

Pratt, Herbert L. (Continued)
Country Life 29:23 *x; 34:43 *; 34:36 *; 36:41 *.

Pratt, John T.
Architectural Record 46:296, 297 *; 49:426 *; 50:318, 335 *.
Country Life 27:41 *; 29:20 *x.
House Beautiful 53:27 *.

Taylor, James B.
Country Life 43:57 *.

Woolworth, F. W.
Architectural Record 47: 195—213 *x.

GLEN HEAD

Havemeyer, T. A.
Garden Magazine and Home Builder 38:328 *.

GREAT NECK

Dreicer, Michael.
Country Life 37:40 *.

Gale, Mrs. George M.
Garden Magazine and Home Builder 39:273 *.

Satterwhite, Dr. Preston Pope.
Country Life 43:53, 56 *.

Schieren, G. Arthur.
Architectural Record 52:351 *.
Garden Magazine and Home Builder 35:120—123 *x.
Country Life 33:62 *.

Wyckoff, Richard D.
Garden Magazine and Home Builder 39:288 *.

HEMPSTEAD

Mulford, The Misses.
House Beautiful 51:211 *.

HUNTINGTON

DeForest, Robert W.

Field, Marshall (Olmsted)

Hare, Meredith
Architectural Record 48:179—191 *x.
Garden Magazine and Home Builder 34:241*.
House and Garden 39:26—29, 1921

Matheson, W. J.

Lianus M. Weld. (Shipman)

Francis N. Weld. (Platt)
Architectural Record 50:256 *.
House Beautiful 53:125 *.

ISLIP

Havemeyer, Horace.
House Beautiful 57: 130, 131 *. (Lawns, trees, shrubs. not much garden)

KENSINGTON (Great Neck)

Dudley, Mrs. F. S.
Country Life 43:49 *.

LAKEVILLE
Sherman, L. H.
House Beautiful 50:455 *.
House and Garden 45:91; 50:455; 55:374.

LLOYD'S NECK
Field, Marshall.
Garden and Home Builder 41:123 *.

LOCUST VALLEY
Bailey, Frank.
Country Life 29:56, 57 *.
Billings, C. K. G.
Country Life 39:54 *.
Cemetery, (Olmsted)
Cravath, Paul D.
Country Life 42:66, 67 *.
Creek Club (Olmsted)
Hodenpyl, A. G.

MASSAPEQUA
Thorn, Mrs. Conde R.
Country Life 50:40 *.

MERRIWOLD PARK
Takamine, Tokichi
Country Life 27:59—63 *x. Shoo Foo Den)

MILL NECK
Cox, Irving.
Country Life 27:59—63 *x. (Shoo Foo Den)
Garden Magazine and Home Builder 39:107 *.
Russel, Fairo.
Architectural Record 50:435—438 *x.
Winmill, Robert C.
Country Life 37:66, 67 *.

OYSTER BAY
Coe, William R. (Olmsted)
Architectural Record 49:195 *x; 54:131, 132 *.

Garden Magazine and Home Builder 37:385 *.
Article on the Orient's Gifts to America.
House and Garden 43:42

Hagar, Mrs. Robert, Jr. (Sauger).
House and Garden 39:34

Jennings, Walter. The Wild Garden

Postley, Sterling. (Leavitt)
Garden Magazine and Home Builder 31: 241 *.

Roosevelt, Mrs. J. West.
Country Life 48:66 *.

Roosevelt, T. Tomb
T. R.'s grave a Mekka of thousands. Literary Digest 62 * 55—58 1919.
American Shrine St. Nicholas 47:841 1920.
American Mecca Outlook 132:210—11 1922.
Permanent and appropriate Roosevelt Memorial Cor. Opinion 67:20 1919.
Plans for Roosevelt Park at Oyster Bay
Scribner's 66:409—12 1919.
Roosevelt Memorial at Oyster Bay
Rev. of Rev. 61:105.

Sanderson, Henry. (Olmsted)
Country Life 42:53, 54 *.
House Beautiful 51:199, 210 *.

Schiff, Mortimer L. (Greenleaf.) (Dean.) The Swable House etc.

Shonnerd, H. S.
House and Garden 4:18, 19, 21.

Simpson, R. H. (Say)
House Beautiful 50:38 *.

Strauss, Albert.
Country Life 47:46, 64, 65 *.

Wetmore, Charles W.
Country Life 18:65

Work, Bertram G.
Architectural Record 54:13, 51:53, 68, 69 *.
Country Life 36:70 *.

ROSLYN

Henderson, Frank C. Estate of
Country Life 41:51—53 *.

Hutton, E. F.
Architectural Record 52 *492—494 *.

Hutton, E. H.
House Beautiful 54:44 *.

MacKay. (Lowell)
Country Life 39:49 *.

Ward, Mrs. Aaron.
Garden Magazine and Home Builder 33:237 *
Article on What America has done for the Iris.
35:235 *.

Whitney, Mrs. Harry Payne.
Her Studio at Wheatley Hills:
Architectural Record 54:13, 47 *.
Country Life 37:25, 28, 29, 37 *; 44:75 *; 46:40; 43:76 *.
Studio at Old Westbury:
Garden Magazine and Home Builder 34:225 *.

SAYVILLE

Foster, Miss M. D.
Country Life 30:42 *.

SEA CLIFF

Levison, J. J.
House Beautiful 57:129, 132 *.
(Lawns, trees, and shrubs—No garden)

SOUTHAMPTON

Barber, Mr. Thomas H.
Country Life 45:36 *.

Breese, James L.
Country Life 27:46—49 *; 38:46 *; 43:71 *.

Coe, Henry E.
Beautiful Gardens In America Pl. 64 *.

Coffin, Mrs. Edmund.
Country Life 48:72 *.
House Beautiful 46:60*

Curtis, George Warrington.
House Beautiful 47:186 *.
Garden Magazine and Home Builder 35:293.

Fry, Marshall.
Country Life 27:42 *.

Henderson, Mrs. C. R.
Country Life 42:38 *.

Morton, Mrs. Paul.
Garden Magazine and Home Builder 33:296 *.

Rogers, H. H. (Olmsted)
Architectural Record 39: 1—23 *x.
Country Life 24:41 *; 35:32 *.
House and Garden 39:59.

Sabine, Charles H. (Coffin)
Country Life 42:53 *; 45:42 *x
Garden Magazine and Home Builder 37:375 *.
Landscape Architecture 13:81 *.

Snow, Mrs. Frederick A. (Fowler).
Country Life 42:34, 40 *
Garden Magazine and Home Builder 38:82 *
Article on Walls and Hedges to Frame the Garden. 34:17 * Article on Making the Most of the Herbaceous Border; 36: 103 * Article on Planting Fruit Trees for Beauty.

Waller, Mrs. Robert.
Country Life 42:36 *.
Wycoff, Mrs. Peter B.
Beautiful Gardens in America pl. V. *
Country Life 32:61 *; 45:38 *.

SYOSSET

Burden, James A.
Architectural Record 54:8, 9, 39, 41 *
Country Life 38:58*; 46:39*.
Morawetz, Victor
Country Life 46:34.
House and Garden 33:22
Robinson, Mrs. Monroe Douglas.
House Beautiful 41:46, 47 *
Senft, Mrs. Charles.
Architectural Farum 41:5 *
House Beautiful 55:374 *
Winthrop, Egerton L.
Garden Magazine and Home Builder 34:289 *; 37:382 *.
House andGarden 37:50

WESTBURY

Bacon, Robert L.
Country Life 43:34 *x; 46:59 *
House Beautiful 53:361 *
House and Garden 32:30
Duryear, Herman B.
American Estates and Gardens, Lerree, p. 43
Hastings, Thomas.
American Country Houses of Today p. 36 *
Keene, Foxhall.
American Estates and Gardens, p. 155—9.
Kramer, A. L.
Garden Magazine and Home Builder 38:73*; 39:128, 129 *; 40:292 *.

Kramer, A. L. (Continued)
House Beautiful 55:255 *; 58:34 * Article on the Edging Plant of the Herbaceous Garden.

Milburn, Devereux.
House andGarden 38:22

Pell, Mrs. Haggerty.
House Beautiful 55:375 *

Phipps Estate.
House Beautiful 57:229—233 *x

Wheelan, George J. (Levison)
Architectural Record 49:333 *

Hicks Nursery.

A NEW FORM OF TRADESCANTIA REFLEXA

ARTHUR D. SLAVIN AND J. A. NIEUWLAND

About a half mile east of Cartier Field on the property of the University of Notre Dame, there has been found growing quite a number of plants of *Tradescantia reflexa* with pure white petals.

The plant grows about 8 dm. high, although there are some which never attain a height of more than 3 dm. General characteristics are the same as those of *Tradescantia reflexa* with some slight differences. The petals are ovate and pure white. Those of the species are almost orbicular. The sepals are a lighter green than in *T. reflexa*. In fruit they turn a decided purple, especially along the margin. They have a small tuft of hairs at the tip. The bracts are deflexed and slightly pilose at the tip.

Tradescantia reflexa forma **albiflora.**

Herba radicibus fibrosis. Caulis nodatus, glaber, 3-8 dm. altus. Folia angustata linearia attenuata, carinata, 2-3 dm. longi, glauca. Involucrum umbellatum. Stamina 6, barbata, petala ovata, alba. Bracteae lineares, attenuatae, 8-10 mm. lengae, reflexae, capillatae.

Nostrae Dominae, Ind. ad orientem versus et prope silvam florens a Maia usque ad Octobrem.

Two subforms of this white flowered plant are present that seem to be uniformly different. One is about half as tall as the other with smaller flowers and more stocky growth. The taller is especially desirable for cultivation since it blooms throughout the season until November.

Book Reviews

AN INTRODUCTION TO THE BIRDS OF PENNSYLVANIA, by George Miksch Sutton, State Ornithologist. J. Horace McFarland Company, Harrisburg, Pa. $1.00. Reviewed by N. M. Grier.

The author starts his account with some practical hints for bird study written in an interesting, inspiring, and autobiographical vein, and then discusses about 250 of the more common species of birds inhabiting the Alleghenian, Carolinian and Canadian life zones. For each bird represented in the State he gives the other names by which it is known, its description, and range in Pennsylvania. To this material he adds many of his own happy observations of bird life.

While this little book will have its greatest value for bird students in the State for which it is written, it should also be very useful for those in the middle Atlantic states. Its simple language well adapts it for the use of the beginner, for bird clubs, nature study and high school classes.

COMMON WILD FLOWERS OF PENNSYLVANIA. E. M. Gress, State Botonist. The Times Tribune Publishing Company, Altoona, Pa. 75c. Reviewed by N. M. Grier.

The author, who will be recalled from his works on "The Grasses of Pennsylvania" and "Pennsylvania Weeds," has given us a splendidly illustrated pocket size work on common wild flowers which will be of aid to students of Botany and Nature Study and Boy and Girl Scouts not only in Pennsylvania, but also in the other middle Atlantic and Central States. Peculiar characteristics and habits, medicinal qualities, relationship to insects, myths, and other interesting information are given in many cases. About fifty plants are fully discussed with remarks and information on approximately two

hundred related species. This handy little volume will be of great value to those who are interested in training the child in the proper use of its recreational period, by helping to bring him into sympathetic contact and relationship with his natural environment.

GRASSES OF INDIANA. C. C. Deam. (1929).

Students of botany, not only of Indiana but the neighboring states as well, will appreciate and be helped very much by this work of the Department of Conservation. Both state and author should be congratulated for the publishing of this volume of exact information. The subject is based not on the plants thought to cover the region, but on those actually and unmistakeably reported, and especially on specimens actually on record in various herbaria. The keys are well arranged, easily run down, and altogether show an exceptional knowledge of the plants in the field.

Since most of them were actually seen or collected by the author, who shows a worthy disinclination to report specimens not coming under his actual observation, or those of doubted authority, years of acquaintance with the Indiana flora stood him in good stead to pronounce on the various reports of earlier writers.

It is comforting also to note that problems of nomenclature and synonomy are left in the background. These can well be eliminated when facts and actualities are dealt with. Nomenclature squabbles can, in fact, best be forgotten by leaving such more or less insignificant matters in abeyance.

—J. A. N.

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